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The Dynamical Deflexion and Strain of Railway Girders.

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(Continued from page 84.)

Uniformly Distributed Load.

We have hitherto considered the effect of a single weight pressing only at one point of the girder. The more important practical case, where the pressure is applied to a considerable surface, remains to be examined.

In entering upon this inquiry, the consideration of horizontal motion will be in the first instance excluded. The distinction between the effects of gradual and instantaneous loading has been already pointed out, in reference to a single weight; and the comparison may now be extended to the case of a uniformly distributed load. If this load be gradually laid on, it produces less deflexion than when laid on all at once. A series of weights applied simultaneously all along the undeflected girder, will move vertically downwards, and acquire momentum which has to be destroyed by an increased exertion of the elastic forces of the girder. In this case, as in that of a single weight, the ultimate deflexion and pressure will be doubled, as will be demonstrated by analogous principles.

The beam being, as before, supposed to be perfectly elastic, the central deflexion is proportional to the weight of the uniformly distributed load. If a be the length of the beam, x the central deflexion, u the weight of a unit of length of the load, we may put $u\,a = \alpha\,x$, where α is a determinate constant.

Let x', y' be co-ordinates of any point in the surface of the beam, which is supposed to have the same curvature as its neutral axis. Then as the curvature is always exceedingly small, $u\,dy'$ is the weight of an element of the load, and $u\,dy'\,dx'$ represents the product of this weight and its virtual velocity, when the centre of the beam is displaced through a small vertical distance dx. The product of all the pressures and the corresponding virtual velocities is equivalent to

$$\int u\,dx'\,dy',$$

taking y' between the limits 0 and a. It may mathematically be shown that this integral is equal to $u\,a\,d\bar{x}$, where $\bar{x}$ is the vertical ordinate of the centre of gravity of the load. Also, from the equations given by Professor Moseley, in his "Principles of Engineering," Art. 374, it may be shown by a simple process, which is here omitted for the sake of brevity, that $\bar{x}$ is proportional to x, and may therefore be put $= \beta x$, where β is a determinate constant.

Hence, $u\,a\,d\bar{x} = a\beta x\,dx$.

The integral of this, between limits 0 and x, is the total work done in producing the central deflexion. This integral is equal to

$$a\beta\frac{x^2}{2} = \frac{ax}{2}.\bar{x}.$$

Or the "work done" is equivalent to that produced by a weight which would statically maintain half the deflexion, moving through the whole space which the centre of gravity actually described. Hence, by the same reasoning as applied to the case of a single weight, *the statical deflexion and pressure are doubled by instantaneous loading.*

Transit of a Continuous Load.

By combining the conclusion just arrived at with the principle which has here been termed the Principle of the Conservation of Work, it is readily seen that the statical strain and deflexion cannot be more than doubled by the transit, at any horizontal velocity, of a uniform load of the same length as the girder. Indeed, the dynamical will in general be considerably less than double the corresponding statical effects.

It has been shown that where the weight of the load sustained is nearly as great or greater than that of the beam, the force required to produce motion in the beam is inconsiderable compared with the actual deflecting forces. The beam itself, therefore, is then always nearly in a state of equilibrium, and its form nearly the same as that which would be statically produced by the external pressures. If this be assumed to be strictly true, it follows that the curve of deflexion is concave in every part, and therefore that no part of the beam sinks while another part is rising—that *all* the parts sink together, and all rise together. The vertical motion is so extremely small and gradual, that there can be no danger in assuming that all the parts arrive at their lowest positions at the same instant. It follows then, as previously to that instant the motion was downwards, and subsequently upwards, the beam in its lowest position is at rest, either instantaneously or for a definite period.

In this position of rest, the pressures on the surface of the beam are in statical equilibrium with its internal forces. At the same time, the pressure produced by the traveling load is the same as if the curve of deflexion were a *fixed* curve.

Effect of Centrifugal Force.

When a body, moving along a fixed curve, is acted upon by no forces but the pressure of the curve and its own weight, the pressure on the curve (by the known principles of mechanics) is equal to the centrifugal force, plus the normal component of the weight. The curvature of a deflected girder is in general so exceedingly small, that it will be quite safe to assume the pressure equal to the centrifugal force, plus the weight itself.—The curve assumed by the surface of the beam depends on the forces acting on it; and we here suppose the beam to be at *rest*, although the load upon it is in motion. Hence, the elastic forces of the beam are in *statical* equilibrium with the pressures on the curve.

The origin of co-ordinates being at one end of the beam, and the axis of x, measured vertically downwards, at any point (x, y) of the curve, the tangent of the angle of horizontal inclination is $\frac{d\,x}{d\,y}$, which is always very small. Hence, neglecting the square of that quantity as inconsiderable compared with unity, we may put the inverse of the radius of curvature at the point $(x, y) = -\frac{d^2\,x}{d\,y^2}$. (The sign never changes, as the curve is everywhere concave upwards.)

From the theory of perfectly elastic beams, it appears that $\frac{d^2\,x}{d\,y^2}$ is, at every part of the beam, proportional to the moment about (x, y) of all the pressure acting between that point and either extremity of the beam. Here, the pressures between (x, y) and the origin are the centrifugal forces and the weights acting downwards, and the pressure of the abutment acting upwards. The moment of all the centrifugal forces may be first ascertained.

Each small portion of the load may be supposed to act independently of the rest, or to press on the curve with its own weight, and its own centrifugal force. Let m be the unit of mass; and therefore, at any point $(x'\ y')$ intermediate between (x, y) and the end of the beam, $m\,d\,y'$ the mass of an element of the load. Calling V its linear velocity, it appears from what has been already said about the radius of curvature, that $V^2\,\frac{d^2\,x'}{d\,y'^2}\,m\,d\,y'$ is the centrifugal force of that element. The moment of this centrifugal force is $-V^2\,\frac{d^2\,x'}{d\,y'^2}\cdot(y-y')\,m\,d\,y'$.

The moment of all the centrifugal forces about the point (x,y) will be found by integrating this expression between the limits $y' = 0$ and $y' = y$. So it may be ascertained that the moment of these forces is

$$m\,V^2\,(y\tan\beta - x),$$

where β is the horizontal inclination of the curve at the origin. $y\tan\beta - x$ is the length of a vertical line drawn downwards from the point (x, y) to meet the tangent drawn from the origin; and is very small.

The weight of the portion of the load upon the horizontal length of the beam y, is $m g y$; and its moment about the point (x, y) is the same as if the weight were collected at a point half way between (x, y) and the origin, and therefore equals $\frac{m g y^2}{2}$. Also, if P be the pressure of the abutment, P y is its moment; and representing the constant, by which the radius of the curvature has to be multiplied to render it equal to the sum of the moments, by E I, we have—

$$\text{E I} \frac{d^2 x}{d y^2} = m g \frac{y^2}{2} - \text{P } y + m \text{V}^2 (y \tan \beta - x).$$

This equation is integrable in its present form; but as the last term of it is very small, we may make an alteration which will tend very much to the simplicity of the results. The centrifugal pressures, cannot, under any circumstances, be great compared with the other forces, as may readily be foreseen by considering that, in all cases of actual practice, the curvature is very small on account of the very small proportion which the central deflexion bears to the length of the beam. *For any central deflexion previously assigned*, the curve would be very little altered if the centrifugal pressure were uniformly distributed. Therefore, in the above equation, the small term $m \text{V}^2 (y \tan \beta - x)$ is neglected in estimating the radius of the curvature merely. Now, it appears from the "Mechanical Principles of Engineering," Art. 374, that when the beam is subject to any uniformly distributed pressures whatever,

$$\frac{d^2 x}{d y^2} = \frac{24 \text{ D}}{5 a^4} (\tfrac{1}{2} y^2 - a y),$$

where a is half the length of the beam, and D is its central deflexion. The curvature of the beam, when it assumes its permanent form under the influence of a passing load, will not greatly differ from that which this equation indicates. Of course, this hypothesis does not suppose the distribution of the centrifugal pressures to be actually uniform—it merely presumes that the curvature of the beam, *for a given deflexion*, is nearly the same as if the pressures were so distributed.

From the equation last given, the value of $\frac{d^2 x}{d y^2}$ at the centre, is $-\frac{24 \text{ D}}{10 a^2}$. Therefore, at the centre, a weight moving with velocity V, has a centrifugal pressure $= \text{V}^2 . \frac{24 \text{ D}}{10 a^2}$ times its mass.

To ascertain the whole effect of centrifugal pressure, we have evidently the expression

$$-\int m \text{V}^2 \frac{d^2 x}{d y^2} d y = -m \text{V}^2 \frac{24 \text{ D}}{5 a^4} \int (\tfrac{1}{2} y^2 - a y) d y,$$

integrating between limits $y = 0$ and $y = 2 a$.

From this, it appears that the total centrifugal pressure

$$= \frac{32}{m} \frac{\text{D}}{\text{V}^2} 10 a, \text{ which becomes } m g a \frac{1}{10} \frac{\text{V}^2}{a^2} \text{D, if } g = 32.$$

Now, if T be the number of seconds in which either end of the load traverses the beam, $V T = 2a$, and $\frac{V^2}{a^2} = \frac{4}{T^2}$. Substituting this value, and remembering that the total weight on the beam is $2 m g a$, we find ultimately,

$$\textit{Centrifugal pressure on whole beam} = \frac{1}{5}\frac{D}{T^2} \times \textit{the weight.}$$

What very strongly confirms this conclusion, and shows that no materially great error is contained in it, is the consideration that if the curve had been supposed to be a *circular* arc passing through the middle and two ends of the curve, the effect of centrifugal pressure would be almost the same as the above formula gives it. The only difference (as will be seen hereafter) would be, that in the formula we must substitute $\frac{1}{4}$ for $\frac{1}{5}$. When it is considered how exceedingly small the curvature of the beam must necessarily be in all practical cases, it becomes clear that a circular arc of large radius would represent the curve with at least tolerable accuracy. At all events, that assumption furnishes a safe test of the foregoing conclusions.

Rule for Calculating the Pressure.

The formula then gives all the information that can be generally required, respecting the influence of the velocity of the train, on its pressure on the deflected girder, when the mass of the former is not small compared with that of the latter. Put into ordinary language, the formula amounts to this—that *when a long uniform load moves over a girder which is perfectly elastic, and originally horizontal, the greatest pressure on the girder is that of the weight on it at any time + a small fraction of that weight, which fraction is found by dividing one-fifth the deflection (in parts of a foot) by the square of the number of seconds in which either end of the load traverses the girder.*

In order to give a clear idea of the value of the formula, and to show how small the influence of velocity generally is, one or two practical applications may be given.

A heavy train moves over a girder 88 feet long, at the rate of a mile a minute, and the observed deflexion is one-third of a foot. To find the pressure on the girder.

In this case, either end of the train moves over the girder in one second. The square of the number of seconds is therefore 1. The deflection is $\frac{1}{3}$. Therefore, the fraction of the weight is $\frac{1}{15}$. Or the extreme pressure on the girder, is one-fifteenth more than the weight on it at any time.

A train moves off a girder in three-fourths of a second, and the observed deflection is one-fourth of a foot.

Here the square of $\frac{3}{4}$ is $\frac{9}{16}$. One-fifth the deflexion is $\frac{1}{20}$; and $\frac{1}{20}$ divided by $\frac{9}{16}$ gives $\frac{4}{45}$; or the pressure is not quite one-twelfth more than the weight at any time on the girder.

These instances give the dynamical pressure as large as it is ever likely to be with a properly-constructed girder-bridge. They consequently show that the dynamical pressure of heavy loads, even at high velocities, very

little exceeds the statical; and at low velocities, differs from it only in an inappreciable degree.

It will be observed, that if the velocity be indefinitely increased, or T in the formula indefinitely diminished, the dynamical pressure is indefinitely increased. But the formula virtually excludes these hypothetical cases; for the investigation proceeded on the assumption that the centrifugal pressures are comparatively small, and that the whole pressure produces but a small deflexion.

Defect of Elasticity.

It now remains that something be said of the defect of elasticity, and the modifications of the above results when applied to jointed or compound structures. The ordinary mathematical theory of the girder is based on the law of perfect elasticity, known as Hooke's law,—namely, that the elastic force is proportional to the extension or compression.

It appears from experimental inquiries, subsequent to, and more extensive than, Dr. Hooke's, that this law is not quite true. The elastic force is in reality less than the law would assign it to be. Mr. Hodgkinson, in his recently published "Researches on Cast Iron," Art. 106, seems inclined to think that the elastic force may be expressed by $a x - b x^2$, where x is the measure of compression or extension, and a and b constant empirical co-efficients. That this hypothesis is near the truth, may be inferred from the consideration that if the elastic force be expressed by a series in ascending powers of x, all terms involving high powers must be very small, as the elastic force is always nearly equal to the first term, and x is very small. It may, however, be worth while to remark, that if $a x - b x^2$ be taken to express correctly the elastic force, the same value of x, which reckoned positively gives the tension, will not, when reckoned negatively, give the same value for the pressure. In order that this may be the case, only uneven powers of x must be involved.

But whatever law of elasticity be assumed, this is easily ascertained—that where the elasticity is imperfect, (that is, where it is less than in proportion to the extension or compression,) the deflecting pressure of a girder will be less than in proportion to the deflexion. In cast iron girders, cast in one piece and in metal of good quality, the defect of elasticity is small; and consequently the deflexion is pretty nearly proportional to the pressure. But in jointed structures, compounded of several parts connected by rivets or bolts, this is by no means the case. In them, the defect of elasticity must be great; and the deflexion will therefore increase at a considerably higher rate than in proportion to the external pressure. If a load of 200 tons produce in a compound girder 2 inches deflexion, 300 tons will produce considerably more than 3 inches deflexion. Or, if 300 tons produce 3 inches deflexion, 400 tons will produce considerably more than 4 inches deflexion. *How* much more can be ascertained only from actual experiment.

It is very important that this distinction between simple and compound girders should be always taken into consideration, for the neglect of it would lead to very erroneous conclusions respecting the strength of structures of the latter kind. As cases in point, may be instanced calculations respecting the strength of girders formed in three pieces and supported by

tension rods. Formulæ which determine the strength of simple, unjointed girders, are inapplicable to these structures, and are not likely to give even an approximation to the amount of their real strength.

Where, however, the compound girder is so well constructed, that its curvature, when deflected, is regular and free from sudden inflexions, the formula given above for the dynamical pressure of long trains on perfectly elastic beams, will apply with considerable accuracy. For the deflexion being previously assigned, is a safeguard against any very great error.—That deflexion being small, the curvature will also be small; only, on account of the defect of elasticity it increases *cæteris paribus* more rapidly towards the centre of the beam, than it would if the beam were perfectly elastic. Consequently, the pressure towards the centre is comparatively greater in the compound, than in the simple girder: and pressure towards the centre is more effectual in producing deflexion than pressure near the ends of the girder.

Consequently, there are two reasons why velocity increases the deflexion of a compound, more than that of a simple girder. In the first place, on account of the defect of elasticity in the jointed structure, its deflexion increases in a higher degree than in proportion to the external pressure. Secondly, that external pressure is of necessity greater for the jointed than for the simple girder, because in the former the curve is sharper towards its centre. Velocity of transit has, therefore, much greater influence on the security of girders of the former, than of the latter kind.

It would have been satisfactory to have been able to confirm the results of these investigations, by reference to actual experiments. Unfortunately, however, there are at present but very scanty data for the purpose. An account of two experiments made on the Dee Bridge of the Holyhead Railway, is all that can be cited. These experiments are described in a Report to the Commissioners of Railways, 15th June, 1847. An engine and tender, about 30 tons weight, passing over the bridge at 15 miles an hour, produced "a deflexion nearly the same as with the engine at rest—viz., from $\frac{7}{8}$ to $1\frac{1}{16}$ of an inch." In another experiment, "an engine and train of 48 tons, at rest, gave a deflexion of 2·4 inches; while the deflexion caused by the same train at a speed of 15 to 20 miles an hour, was only $1\frac{5}{8}$ of an inch."

These accounts do not, however, furnish much information suited to our present purpose. In the first place, the experiments were made on a jointed structure of a complex nature, and of which the deflexion appears, even from this brief account, to have followed no simple law. Moreover, in the first experiment, the deflexion is not accurately determined: it is merely said to have been from $\frac{7}{8}$ of an inch to three-sixteenths more; and, in both, the mass of the girder greatly exceeded the mass sustained.—All the inference that can be drawn is, that velocity did not very materially influence the deflexion, but that the deflexion was diminished at the highest velocity, the load sustained being comparatively light.

Means of Diminishing the Dynamical Pressure.

When a ball moves along a perfectly horizontal surface, the pressure on its under side is just equal to its weight, for this simple reason—that if the pressure were greater, the ball would rise; if less, sink.

In the same way, if a train moved along the surface of a girder which remained perfectly horizontal during the transit, its pressure would be just equal to its weight. But the train generally sinks a little, and acquires a momentum downwards, which has to be destroyed by increased pressure. The simplest precaution against this effect is—not to remedy it—but to prevent its existence. Suppose it be found that, when a certain weight travels along a certain girder which is originally perfectly horizontal, it produces a deflexion of three inches at its centre: then, if the rails had a rise given them of three inches towards the centre, it is clear, that when the same weight traveled over them, it would be no lower when at the centre, than when at either end of the beam.

Suppose now the reverse case—that there is a hollow or depression originally in the beam. Then, when the weight passes over the beam, it sinks the distance of this original depression, in addition to the deflexion produced by pressure. Hence, the downward momentum is materially greater than if the beam had been perfectly horizontal originally. Or, to take another view of the question, the original hollow or depression, added to the deflexion, increases the curvature of the beam, and therefore the centrifugal pressure of the load. Either way, then, of viewing the effect of the hollow, either in increasing the momentum downwards, or in increasing the centrifugal pressure, leads to the same result—that the pressure is increased. Mathematically, these two views of the case coincide.

It is seen, then, how extremely important it is that there should be no original hollow in the beam. On the contrary, it is advantageous that its surface should be convex, instead of concave—or should have a *camber*. In this case, the centrifugal pressure would act upwards instead of downwards; so that the pressure, instead of being greater than the weight, would be less at high speeds.

There is a very simple way of calculating this diminution, or of estimating the centrifugal force. And it may be remarked, parenthetically, that the method about to be given is useful for many purposes besides that to which we are to apply it. For example, it furnishes most simple and ready means of ascertaining the horizontal pressure on the flanches of the wheels of carriages going round railway curves.

If a be the length of the chord of a circular arc, which is of large radius, and x its lineal versed-sine, or the length of the perpendicular drawn from the centre of the arc to the chord, it will be found that the radius nearly equals $\frac{a^2}{8x}$.

Now, if V be the velocity of a mass m, moving round this curve, its centrifugal force becomes $m\ \mathrm{V}^2\ \frac{8\ x}{a^2}$; and if T be the number of seconds in which any part of the mass describes the distance a, $\frac{\mathrm{V}^2}{a^2} = \frac{1}{\mathrm{T}^2}$.

Substituting this value, and putting $g = 32$, the centrifugal force is equal to $\frac{x}{4\ \mathrm{T}^2} \times$ the weight. This formula applies to horizontal railway curves, as well as to the vertical curves of a beam. Confining attention, however, to this application of it, we see that a very considerable reduc-

tion of the pressure of the weight may be effected by curving the upper surface of the beam. Suppose, for instance, that the time of transit were one second ($T = 1$), and that it were practicable to give the rails such a convexity that the rise at the centre was one foot ($x = 1$). Then, from the formula, it appears that the centrifugal pressure would be one-fourth the weight, or that only three-fourths the weight pressed on the beam.

It may be remarked that this law has most important effects on such stupendous structures as the tubular bridges for the Chester and Holyhead Railway. The Conway bridge, after it was constructed, sank eight inches at the centre by its own weight; this depression was anticipated and corrected by a previous upward convexity of the tube. But in this, and all analogous cases, a rise or convexity, considerably *exceeding* the natural depression, would tend greatly to security: because, the curve being convex, an increase of the velocity would diminish, instead of increasing, the pressure of a given load. It may, therefore, be safely asserted, that it *contributes to the security of girders to give their upper surfaces as great a convexity as is consistent with other practical requirements.*

General Conclusions.

At the close of these investigations, it may be convenient to recapitulate the general conclusions derived from them. They comprehend the following laws for the motion of very heavy loads at practical velocities over horizontal girders.

1. If the girder be perfectly elastic, the pressure exceeds the weight on the girder by a fraction of the weight, not more than one-fifth the actual deflexion, (in parts of a foot,) divided by the square of the number of seconds in which either end of the load traverses the girder.
2. In compound and imperfectly elastic girders this fraction is increased.
3. The influence of the inertia of the beam on its deflexion is inconsiderable.
4. In all girders, a convexity of their upper surface, or rise of the rails from end to centre, may be made to materially diminish the pressure.

These conclusions will, it is believed, furnish a tolerably accurate idea of the influence of moving loads upon railway girders. The only subject on which no definite investigation has been here attempted, is the defect of elasticity in jointed girders. The modes of construction of compound girders are so numerous, that to establish any general law respecting them is obviously impossible—no accurate knowledge can be derived of the law of elasticity or deflexion in these cases, but by direct experiment.

No pains have been spared to render the views here expressed, correct. They have occupied many months of reflection, and have been subjected to the careful revision of the author's mathematical friends. As the great object has been to exclude all operose mathematical investigations, it will be readily understood that the subject, by constant corrections and simplifications, has assumed an entirely different shape to that originally given to it.

The Central Railway Station, Newcastle-upon-Tyne.

JOHN DOBSON, ESQ., Architect.

Railway buildings ought to do much for architecture: being quite a new class of structures, erected for purposes unknown until the present age, or, we may say, the present generation, they suggest, or ought to suggest, a character of their own, and fresh combinations in design; and being generally upon an extensive scale, they afford opportunities that have hitherto been of rare occurrence. They are, moreover, especially public works—structures constantly seen by thousands and tens of thousands of persons; and might, therefore do much towards improving the taste of the public. That they have done so, or have been calculated to do so, cannot, we fear, be asserted of them generally. In more than one instance, expression has been falsified or forfeited, by the adoption of some style intended to be reminiscent of mediævalism—of times whose spirit and whose institutions contrast very strongly with the present railway age, in which it is either our good luck or our misfortune to live. All the various modes of Gothic are very ill adapted to buildings totally different in purpose, and therefore requiring to be differently constituted from those in which such modes are exemplified. Either violence—or what is likely to be thought such—must be done to the style itself, by deviating greatly from its traditional physiognomy, or mediæval physiognomy will be in contradiction to modern purpose. The character aimed at may be well kept up; but in proportion that it is so, it will be foreign from the express occasion—for what class of mediæval structures are there that have aught in common with railway stations and termini? Is it the castellated with its feudal fortresses?—or the ecclesiastical with its churches and conventual buildings, its priories and abbeys?—or the palatial, or the collegiate, or the domestic? Is there any one of those styles or classes which supplies what is required for railway structures as a specific class, that ought to carry with them a distinct and appropriate character of their own? The Gothic style does not readily provide open external halls or ambulatories, which, if not indispensably demanded, are highly desirable adjuncts to every principal railway station where there is a great confluence of passengers. It is only in the form of the cloister, that Gothic examples supply any accommodation of that kind; and, besides that the cloister or arcade was hardly ever made an external feature, it is one that carries with it associations that, unless it were to be greatly modified, rather unfit than at all recommend it.

It will be in the recollection of our readers, that at Newcastle the great eastern trunk line of railway from London to Edinburgh is intersected by a main line of railway extending across the island, from sea to sea: that is to say, from Maryport, on the Irish Channel, to Tynemouth, on the German Ocean. The traffic of this cross line has lately been added to that of the original line from York to Berwick, by the leasing of the Newcastle and Carlisle, and Carlisle and Maryport Railways, to the York, Newcastle, and Berwick Company; and the local traffic of the great northern mining district gives employment to branches from Newcastle to North Shields and Tynemouth, to South Shields, and to Sunderland. Thus, with the

despatch of the through trains, at least 140 arrivals and departures of passenger trains will take place daily at the central station; and it is to provide for this immense accumulation of traffic that the present building is required. It will readily be imagined, therefore, that the sheds and erections must necessarily be upon a scale of no ordinary magnitude. In the infancy of the railway system, no one could have ventured to predict the extent to which the inland traffic has increased; and we have, therefore, seen the great expense which has been incurred by the London and North Western, and other railway companies, to obtain additional room for their principal stations, and the great sacrifice of valuable property which has in consequence taken place. The York, Newcastle, and Berwick Railway Company, however, having had the benefit of the experience of later years, have taken great pains to select a site where the necessary extent of ground can be obtained, with the most ready access to the centre of the town; and they have been fortunate enough to find a spot which, at a very reasonable cost, and with the destruction of very few buildings, combines both these advantages. The manner in which the junction of the northern and southern with the eastern and western lines has been effected,—and the great works required to complete the union of the whole, by means of the high level bridge over the Tyne viaduct, through Newcastle and Gateshead, from the designs of Mr. Robert Stephenson, and under the able management of Mr. Thomas Harrison,—form too extensive a subject to be treated of here, and will probably be the object of a separate notice.

The identity of the central points of the great railway system of this period with the central points of the military occupation of the country by the Normans, has been, in many instances, strikingly exemplified; and in none more so than at York, Newcastle, and Berwick, in each of which towns the railway station closely adjoins the Castle. The station at Newcastle extends from Westmoreland-place, the ancient town house of the illustrious family of the Nevilles, Earls of Westmoreland, situate in Westgate street; takes in the site of the convent and garden of the Carmelites or White Friars, known as the Spital, for many years occupied as the Royal Free Grammar School, the *alma mater* of Lord Stowell, Lord Eldon, and Lord Collingwood; crosses the town wall and ditch at West Spital Tower, and terminates at the Forth, an open piece of ground formerly in the outskirts of the town, and which was bequeathed by some worthy of former days to the burgesses of Newcastle, "to walk abroad and recreate themselves," a circumstance which has hitherto prevented its being built upon.

The façade or principal front, exclusive of the hotel, is 600 feet in length. The style of the building is Roman, and the most striking feature in the design is the portico in the centre, 200 feet in length by 70 feet in width, flanked on each side by an arcade the same length, by 35 feet in width, allowing sufficient room for carriages to drive in at the end of each arcade, to turn, and go out at each end of the projecting part of the portico. The convenience of this plan in such a climate as ours, allowing passengers and luggage to be loaded and unloaded under cover, will at once be apparent: and the grandeur of the effect produced by an arcade and portico of this length will readily be comprehended, even by the general reader, although no drawing will convey an adequate idea of that effect.

The exterior front of the portico is composed of seven arches, each 14 feet in width by 32 feet in height, divided by coupled insulated Doric columns, 29 feet in height, elevated on a basement of 7½ feet, and supporting a broken entablature and attic of the same style. The arcades on each side are formed of arches, of the same width as the portico, divided by coupled inserted columns. These columns, with the key-stones of the arches, support a continued unbroken entablature, without an attic. The ends of the arcades terminate in front in a niche, having coupled insulated columns on each side, supporting an entablature and low attic. The entrance to the end of each arcade is by an arch 25 feet in width, and the arcades will be covered with groined ceilings of stone, with a circular light at each intersection.

The front of the station-house facing the platform is concave, forming the segment of a circle of 800 feet radius. This form was rendered necessary by the junction of the various lines of railway at this point; and the elevation is of rubble stone, from Prudham Quarry, of a plain and bold Roman character, the doors and windows having arched heads, with moulded imposts and archivolts; and the long continued line of these circular arches, with their deep reveals, produces a striking effect.

The shed is 236 yards long, and 61 yards wide, covering an area of 14,426 yards, or about three acres. The roof is composed of iron, divided into three compartments, and supported by columns 33 feet apart, and 23 feet high from the platform to the springing of the roof. The various offices, waiting-rooms, and refreshment-rooms, front the platform, with the exception of the booking-office and parcels-offices, which extend the full width of the building.

The entrance to the shed is, from the centre of the portico, 40 feet wide, with a stone vaulted ceiling, supported by two rows of columns, which leads direct to the centre of the platform, about 120 feet square. On the right hand is the booking-office, 70 feet long by 36 feet wide; adjoining which are the two parcels-offices, the telegraph-office, lamp-room, and other rooms and offices extending westward, for the engineers, guards, porters, and other officers of the company. A house for the station-master concludes the front range of buildings to the west.

On the left of the entrance is the station-master's office, first, second, and third class waiting-rooms, (containing separate apartments for ladies and gentlemen,) washing-rooms, attendants' rooms, and other requisites. Adjoining this suite of rooms is the first-class refreshment-room, 66 feet long by 33 feet wide. At one end is a distinct refreshment-room for ladies, and at the other end a corresponding room for the bar, each 15 feet by 23 feet, divided from the large refreshment-room by columns only, and forming with it one large apartment, 96 feet in length. Adjoining the bar is the second-class refreshment-room, which terminates on the east the range of building facing the platform. The kitchens form the eastern end of the front building, immediately behind the refreshment-rooms, and adjoining the hotel; and are provided with larders, store-rooms, and servants' rooms, on the same floor, with sleeping apartments above.

In addition to the above extensive range of building, it is proposed to erect an hotel, communicating with the station, forming a separate range 190 feet in length by 66 feet in depth; to contain 70 bed-rooms, with a

proportionate number of other apartments; and in the basement story, tap-rooms and refreshment-rooms for servants and other persons.

The construction of this building entirely of stone, would, in any other locality, be attended with enormous expense; but the county of Northumberland affords such an abundant supply of the finest freestone, that this material becomes there not only by far the most durable, but really the least expensive. Ibib. Dec. 1848.

The Conway Tubular Bridge.

On Thursday week the second tube was floated on pontoons to the piers. Its entire length is 424 feet, the actual span over the Conway being 400 feet; its greatest inside width is 14 feet throughout; its height 22½ feet at each end, but rising to 25 feet in the middle, the additional three feet being given to lessen the deflexion of the bases. The total weight of each tube is 1300 tons, so that the superimposed weight, now that the two tubes are at rest over the Conway, is 2600 tons burthen from bank to bank. The fabric may be said to form a series of iron plates riveted together, like armor-work. It has taken twelve months to complete. Each tube has cost about £60,000. Lond. Build., Oct. 1848.

Thames Tunnel.

The number of passengers who passed through the Tunnel in the week ending October 7, was 15,947; amount of money, £66 8*s.* 11*d.* Ibid.

Hodgson's Parabolic Propeller in Holland.

It is now more than four years since this propeller was patented in England, and some very successful trials made with it on the Thames. How it has since fallen into neglect in this country, we know not; but certain it is, that it has, in the meanwhile, attained to high honor among a neighboring people and seems likely to supersede with them the use of the screw. We subjoin a translation of the official report made by a commission of Dutch naval officers, appointed to superintend a series of experimental trials of this form of propeller; also a statement of its subsequent performances in his Netherland Majesty's steam-ship Samarang; and, lastly, an estimate of its capabilities as compared with other propellers, deduced from the data as obtained:

1. *Official Report of Commission of Dutch Naval Officers, on Hodgson's Steam Propeller.*

In pursuance of the order of his Excellency, the Minister of the Navy, sundry experimental trips were made with his Majesty's steam-ship Samarang, in presence of the undersigned parties, who were united in a commission for that object, in order to compare several different submerged propellers.

Of the said experimental trips, which were made in smooth water, and

at the same draught, between Rotterdam and the Brill, the Commission has drawn up the following results, in which the statements express the averages of the observations:—

Experimental Trip on the 11th November, with a four-bladed screw.

The distance was 7·43 German miles per watch, (or knots per hour,) at 36⅜ double piston strokes per minute, under a steam pressure in the boiler of 5¾ Eng. lbs. per square Eng. inch. The barometer gauge of the condenser indicated 26 11/14 Eng. inches, while the atmospheric barometer stood at 29½.

A light top-gallant breeze from S. S. W.

Experimental Trip on the 13th November, with the Parabolic Propeller of Mr. Hodgson.

Rate, 7·77 knots; 37⅝ piston strokes; steam, about 6 lbs. Condenser barometer, 26¼ inch. Atmospheric barometer, 29 5/12. Wind N. N. W., blowing a light top-gallant breeze to a reefed topsail breeze. Squally weather.

Experimental Trip on the 16th November, with a two-bladed screw, the course and centre line of which is the same as the four-bladed ones.

Rate, 7·42 knots; 41¼ double strokes; steam pressure in the boiler, 6 7/12 lbs. Barometer of condenser, 25⅞ inches. The atmospheric barometer, 29⅓. Wind N. N. W., from a variable top-gallant breeze to a calm.

[Signed] The Naval Lieutenants,

J. Welterbach,
J. L. Van Florensteyer,
D. L. Wolfson.

The Engineer in the Steamboat Service,
D. Van Den Bosch.

Rotterdam, the 29th November, 1847.

2. *Statement of Performances of the Samarang in Voyage to the East Indies.*

In consequence of the preceding Report, the screw was permanently superseded in the Samarang by the parabola, (Nov. 1847,) and the vessel proceeded to sea to join the Dutch squadron at Batavia. The following extract from the Report of the Commander will suffice to show how she behaved on the passage out:

"*Under steam alone.*—With a light breeze, and going with the wind, her speed was 6¾ and 7 knots, with steam of not more than 3 lbs., the throttle-valve one-third open, and 31 double piston strokes."

3. *Comparative Estimate.*

As the power exerted is in the ratio of the cubes of the velocities, and as 31 strokes of the engine with 3 lbs. steam was exerted, whilst at Rotterdam the power was 38 strokes of the engine with 6 lbs. steam, it follows, therefore, by calculation, that if, with the former power exerted, the mean speed was 6·875 knots, with the latter it would have been 9·27 knots; and this agrees nearly, allowing for the state of the weather, with the

speed attained at Rotterdam, where the maximum was 8·5 knots blowing hard with the wind a-beam. The effect of this may be appreciated by the remark of the authorities at Woolwich, on a trial with the screw on the "Rattler," viz.—"A fresh breeze a-beam, which must have retarded the vessel to some extent."

In estimating the slip of the propeller by comparison with the result of the best effort of the screw on her Majesty's steam-ship "Dwarf," the following statement, in juxtaposition, is very conclusive:

	Parabola.	Screw.
Diameter of propeller,	5 ft. 11 ins.	5 ft. 8 ins.
Pitch of do.	7·6 ft.	8 ft.
Revolutions of engine per minute,	31	30·124
Do. of propeller,	114·452	155·441
Ratio of revolutions of propeller to the engine,	3·692 : 1	5·16 : 1
Speed of propeller per hour,	8·578	12·264
Do. of vessel "	6·875	8·939
Slip of propeller per cent.	19·854	27·112, or 7·258

per cent. more slip of the screw, with very nearly 43 per cent. higher velocity of propeller, and steam pressure 11·2 lbs. to that of 3 lbs. per square inch.

The following is a comparative statement of the experiments at Rotterdam:—

	4-bladed Parabola.	4-bladed Screw.	2-bladed Screw.
Diameter of propeller,	5 ft. 11 ins.	6 ft.	6 ft.
Pitch of do.	7·6 ft.	8	8
Revolutions of engine per min.	37·833	36·833	41·250
Do. of propeller,	139·679	135·987	152·295
Ratio of revolutions of propeller to the engine,	3·692		
Speed of propeller per hour,	10·469 knots.	10·728	12·015 k.
Maximum speed of vessel do.	8·500	7·875	8·000
Slip of propeller per cent.	18·820	26·600	33·420
Difference of slip in favor of the parabola, as compared with the 4-bladed screw,	7·780		

And with the 2-bladed screw, 14·600 per cent., under adverse circumstances of wind, as the following extracts from the official report show:

Parabola:—"Wind N. N. W., blowing a light top-gallant breeze to a single-reefed topsail breeze. Squally weather."

4-bladed screw:—"A light top-gallant breeze from S. S. W."

2-bladed screw:—"Wind N. N. W., with a variable top-gallant breeze to a calm."

Lond. Mec. Mag., Aug. 1848.

Extracts from the Fourteenth Annual Report of the Directors of the Western Railroad Corporation, to the Stockholders, January 1849.

The following is a Report of the Directors of the Western Railroad, for the financial year which terminated on the 30th of November, 1848.

TRANSPORTATION DEPARTMENT.

The balance to the credit of the Contingent Fund at the commencement of the year, was - -			$185,803·77
The income of the Road has been:—			
From Passengers,	$551,038·43		
" Freight,	745,909·76		
" Mails, Rents, &c.,	35,120·10		
		$1,332,068·29	
The Expenses have been:—			
For Road repairs,	$154,660·86		
" Engine repairs,	48,273·63		
" Freight and Passenger Car repairs,	65,610·68		
" Buildings, &c.,	35,919·10		
" Transportation expenses,	308,711·41		
" General expenses,	39,181·43		
		652,357·11	
Nett Earnings for the year,		$679,711·18	
From this deduct:—			
Balance of interest,	$266,380·77		
One dividend of 4 per ct. on 40,000 shares, $160,000			
1 do. on 51,500 do. 206,000			
	366,000·00		
		632,380·77	
Leaving a surplus for the year of - -			47,330·41
And a total surplus, November 30, 1848, of			$233,143·18

Of this amount, $45,833·34 will be required for payment into the Sinking Funds, for eleven-twelfths of $50,000, Jan. 1, 1849, thus reducing the available contingent fund to $187,300·84.

It will be seen by the foregoing statement, that the earnings of the road for the year have been such as to enable the Company to pay its interest, divide two four per cent. dividends to the shareholders, provide for the Sinking Funds, and to add something to the Contingent Fund. During the year great pains have been taken to improve the road, by removing bad material from under the rails, and substituting good therefor, also by widening and deepening the ditches. Upon four miles of track, the rails originally laid, weighing 56 lbs. to the yard, have been taken up and replaced by new rails weighing 70 lbs. per yard. This required 440 tons of rails, which cost the Company $28,600. During the year 65,000 new sleepers have been put down, which is 25,000 more than the average number required. The cost of the 25,000 extra sleepers, amounting to $12,500, and the iron, amounting to $28,600, have both been charged to current expenses. There has been erected 1079 feet of new bridges for a second track, and one-third of the cost, amounting to $7000, has been charged

to the expenses of the year. A new and convenient steam ferry boat has been built, and $6294·32 of the cost has been charged to the current expenses. The cars and engines have been put in first rate condition, and it is believed that the road and its equipment are now in a much better condition than at the commencement of the year.

Twenty-five 23 net ton engines and 400 freight cars have been added to the stock during the year; a large and commodious depôt has been built at Greenbush, and about thirty-two miles of second track has been laid down, which have enabled the Company to do all the business which has offered promptly, and, as it is believed, satisfactorily to the public. The passenger trains have run regularly through the year, and no injury has been sustained by any passenger. The men employed upon the road and freight trains have been very fortunate, but few of them having been injured during the year. All the bridges between Worcester and Springfield have been raised sufficiently high to clear the heads of persons standing upon the trains, which has prevented this class of accidents.

[In Vol. xv. p. 328, of our Journal, will be found the tables exhibiting the amount of money received from all sources, the number of passengers and of tons of goods transported, and the number of miles run by locomotive engines upon this road, up to the end of last year, taken from the last report. We add the same items for the present year.]

TABLE B.—*Number of Way and Through Passengers in* 1848.

	1st Class.	2d Class.	Total.
Through Passengers,	21,647	12,084	33,731
Way do.,	287,480	84,403	371,883
Grand Totals,	309,127	96,487	405,614

TABLE C.—*Number of Tons Transported in* 1848.

Westward.		
Through from Boston to Albany,	10,808	
All other Tonnage,	68,610	
Total going westward,		79,418
Eastward.		
Through from Albany to Boston,	63,667	
All other tonnage,	122,457	
Total going eastward,		186,124
Total number of tons moved,		265,542
Equivalent to number of tons carried over one mile,		24,656,129
Do. do. do. do. the whole road,		158,052

Miles run by Locomotive Engines in 1848.

Passenger Trains,	243,152
Freight Trains,	454,272
Gravel Trains, &c.,	107,068
Total number of miles run,	804,492

AMERICAN PATENTS.

List of American Patents which issued in the month of February, 1848, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents, in the U. S. Patent Office.*

1. For an *Improvement in Making Shirts;* O. F. Winchester, Baltimore, Maryland, February 1.

The patentee says,—"I cut the neck of the shirt on the yoke, which I prefer to use, with a curve on the shoulder, making a seam on the centre of the shoulder, by which I cut the parts so as to bring all the pressure upon the shoulder at the points, easing it off a little towards the collar, so as not to choke, but still fitting the neck sufficiently well. By this mode I suspend the shirt upon the shoulder, and preserve a perfect fit around the neck and upper part of the bosom;—to fit more perfectly, I cut away the bosom on each side where it joins the yoke, in the curved line; this draws back the edges of the bosom, and fits it to the body."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the neck of a shirt or yoke, by having a curved seam on the top of the shoulder, substantially as set forth."

2. For an *Improvement in Spark Arresters;* John S. Lafitte, Baltimore, Maryland, February 1.

Claim.—"What I claim as constituting my invention, and for which I ask letters patent, is the combining with an open stack or chimney, into which an exhaust pipe projects, in the manner described, the circular flue and its partition forming the receptacle into which the sparks are driven by centrifugal action; the arrangement and construction of the parts being made in the manner and upon the principles set forth."

3. For an *Improvement in Connecting Pumps with Hydraulic Presses or Rams;* Robert Dillon, City of New York, February 1.

The patentee says,—"The nature of my invention consists mainly in the combination of two or more valves, loaded to minor pressures with the common lever used on horizontal pumps, the same being for the purpose of disconnecting one or more of a set of such pumps, to which they are attached, from the press, and by this means concentrating the driving power in a constantly diminishing number of pumps, as there is necessity for it; and finally, combining the entire driving power to such pumps as are loaded to the maximum pressure required."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the valves introduced into, and combined with, the discharge pipes of hydraulic force pumps, and with the safety valve levers of the same, in the manner set forth, for governing the action of said pumps when operating upon the hydraulic ram; and this without confining myself to the precise position or number of said pumps or valves, as placed within the discharge pipe, provided the results produced are the same."

4. For an *Improvement in Car Wheels;* W. V. Many, Albany, New York, February 1.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of making cast and wrought iron wheels for railroad cars with chilled rims, by casting the hub or rim, or both, on to the highly heated wrought iron connexions as set forth, that these (the connexions between the hub and rim) may contract in cooling with the cast iron as set forth."

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5. For an *Improvement in Raising Tilting Pumps;* John J. Vedder and Henry Vine, Schenectady, New York, February 1.

The patentees say,—"The nature of our improvement consists in attaching a flat guide-piece to the rope to which the bale of the bucket is attached; said guide-piece being made to pass through an opening in the stationary frame, so as always to present that part of the rim of the bucket which is at right angles to the bale to the canting hook—a difficulty that has heretofore prevented the use of a single rope with a bucket and canting hook, in consequence of its liability to turn and not present itself properly to the canting hook, to remedy which defect resort has been had to a double rope, which is both expensive and inconvenient."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the employment of the flat tempered bar and the guide, as set forth, for presenting the bucket properly to the canting hook when one rope or band only is used, substantially as set forth."

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6. For an *Improvement in Axles for Carriages;* Samuel Adams, assigned to Sloane & Leggett, City of New York, February 1.

The patentee says,—"My improvements are as follows: On to the arms of a wrought iron axle I cast a shell which forms the journal, and is chilled, so as to wear a greater length of time than the ordinary axle, and the box is fastened on to the axle in such a way as to be set up till it runs steady, and is easily detached, while it is not liable to come off by accident."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is forming the recess in the journal or arm of the axle, in combination with the journal box constructed as set forth. I also claim the employment of the socket and set screw, in combination with the journal box and projections for fastening the wheel to the axle, as set forth."

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7. For an *Improvement in Molasses Faucets;* David D. Hanson, Weare, Hillsborough county, New Hampshire, February 1.

The patentee says,—"The nature of my invention consists in providing the faucet with a graduated scale, circular index, or what is better known among mechanics by the 'ratch dial.' It is so constructed as to show the number of measures drawn from the cask to which it is affixed."

Claim —"What I claim as my invention, is the application of the ratch dial to the faucet."

8. For an *Improvement in Machinery for Knitting;* Joseph Whitworth, Manchester, England, February 1; English patent dated July 1, 1847.

The patentee says,—"My invention consists of improvements in that description of machinery for which letters patent were granted to me, in conjunction with J. Wilde, on the 10th day of November, 1835, in England, which machinery produced knitted fabrics by means of a series of vertical needles, fixed to a bar which progressively moved past a peculiar arrangement of apparatus, by which a loop was made on each needle in succession, and drawn through the loop previously on the needle. Now, according to my present improvements, in addition to having arranged the machine so as to use the bar with needles out of the vertical position, and so that the work, as it is produced, may hang on and below the needles, I have made several improvements in some of the parts or instruments of the apparatus for producing the stitches or loops on the needles, and also in the cams which give motion to such instruments or parts of the apparatus, and I have also improved the construction and arrangement of the bar which carries the needles, and the means for giving motion to such bar."

Claim.—"What I claim as my invention, is the combination and arrangement of parts for working the pressure lever, and the same in combination with the other apparatus and parts as set forth."

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9. For an *Improvement in Molasses Faucets;* Erastus Stebbins, Cabotsville, Hampden county, Massachusetts, February 1.

Claim.—"What I claim, is the application of the directing tube to the upper side of the valve, and the making the orifice of the valve smaller than the orifice of the lower plate of the faucet, the same being in manner as set forth. I also claim the clearer, in combination with the faucet, for the object set forth."

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10. For an *Improvement in Cultivators;* Daniel S. Billing, Conneaut, Crawford county, Pennsylvania, February 1.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the elliptic curve on the outside of the wheels, and the use of a tooth or teeth on each curve opposite the hubs, in combination with the cultivator frame as constructed."

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11. For an *Improvement in Molasses Faucets;* Joseph Dudley, Fall River, Bristol county, Massachusetts, February 1.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the clamping lever and screw, in combination with the valve and seat plate, the whole being arranged and operating together as set forth."

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12. For an *Improvement in Faucets;* William Ball, Cabotsville, Hampden county, Massachusetts, February 1.

Claim.—"What I claim as my invention, and desire to secure by letters

patent, is the combination of the lubricating chamber with the two outer and inner tubes of the faucet, the whole being effected substantially in the manner and for the purposes set forth."

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13. For an *Improvement in Machinery for Compressing Fleeces of Wool;* Lewis Tupper, Genoa, Cayuga county, New York, February 8.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the curved fingers, closers, ring, and lever, constructed, arranged, and operated, substantially as set forth."

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14. For an *Improvement in Drawing Rolls for Spinning Machinery;* Danl. R. Pratt, Worcester, Worcester county, Massachusetts, February 8.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the covering of all kinds of drawing rollers, intended to operate upon wool or cotton roving or yarn, with hollow cylinders of vulcanized india rubber, in the manner and for the purpose set forth—the ends of the elastic contractile covering being lessened in diameter at the ends of the metallic cylinder, and grooving next the shoulders."

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15. For an *Improvement in the Revolving Spring Punch;* Solyman Merrick, Springfield, Massachusetts, February 8.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner or mode in which I effectually prevent the punches from improperly moving while in the act of cutting, viz., by one or more right angular notches, and one or more right angular shoulders, in combination with or applied to them, and the spring jaws as set forth. I also claim the cone, as arranged with respect to the punches, and combined with the space of the cylinder, substantially in manner and for the purposes set forth."

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16. For an *Improvement in Air Heating Furnaces;* John Barker, Baltimore, Maryland, February 8.

The patentee says,—"In my improved air heating furnace, instead of erecting a single brick wall and arching it over, I erect two walls, both of which are arched over, leaving a space, say of an inch or two, between the two walls and arches, which space being occupied by a bad conductor of heat, (atmospheric air,) has the effect of keeping the outer wall and arch at a low temperature, which not only economizes the heat, but allows of the ready descent of the cool atmospheric air on the outside of the outer wall, which air is to pass down between it and the walls of the apartment in which the furnace is situated, and is to enter the heating compartment through openings at the lower part of the walls, as in the structure described in my original patent."

Claim.—"What I claim as new, and desire to secure by letters patent, is, first, the enclosing of the air heating chamber within a double arch, in such manner as to admit of the entrance of a stratum of cool air between such arches and their sustaining walls, said air being made to descend in

the manner set forth, between the walls of the outer arch and those of the enclosing compartment. I also claim the manner of arranging the pipes, so as to cause a current of cold air to be brought into contact with the former by means of the latter, as described. I likewise claim the manner of employing the pipe for causing a lateral current of air to pass over the top of the stove, in combination with the openings for the introduction of said air, under an arrangement and combination of parts the same with that made known."

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17. For an *Improvement in Sash Fasteners;* William Baker, Utica, Oneida county, New York, February 8. (Ante dated August 8, 1847.)

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the tumbler with the pin, curved slot, and catch, substantially as set forth."

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18. For an *Improvement in Organ Pianos;* Rufus Nutting, Romeo, Macomb county, Michigan, February 8.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the caps combined with the reed plates, whether constructed as described, or in other modes substantially the same, by which analogous results are produced. 2d, I claim the additional sounding board, placed over the caps. 3d, I claim the inclined sounding boards under the reeds. 4th, I claim the wind chests combined with the receiver and reed plate, whether constructed in the manner described or others substantially the same, for the purposes set forth."

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19. For an *Improvement in Cooking Stoves;* G. S. Bosworth, Boston, Massachusetts, February 8.

Claim.—"What I claim as my improvement, and desire to secure by letters patent, is, first, the arrangement or extension of the bottom plate of the oven, so that the smoke, &c., after passing down the descending flues, shall impinge upon a portion of the upper side of said plate; and also the combination of said plates, so extended, with the smoke flues above and below, as described."

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20. For an *Improvement in Coal Breakers;* William De Haven and Philip Umboltz, Minersville, Schuylkill county, Pennsylvania, February 8.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the manner in which we have arranged and combined the respective parts, consisting of a single hollow cylinder furnished with teeth, and having perforations through it, and of the plate on one side of said cylinder, which also is perforated, and is furnished with a row of teeth on its lower edge; the whole arrangement and combination being substantially as set forth."

21. For an *Improvement in Ladies' Corded Skirts;* William E. Meginnis, Philadelphia, Pennsylvania, February 8.

Claim.—"What I claim as my invention, and desire to secure by letters patent, in the method of making ladies' self-adjusting skirts, is introducing in alternate order, threads or cords of manilla or other elastic material, twisted in opposite directions, with the cloth of which the skirt is composed, in alternate order, so that a thread or cord whose fibres are twisted to the left, shall counteract the tendency to kink of the next adjacent cord or thread, whose fibres are twisted to the right, by which the skirting is prevented from kinking, and by which the dress is retained in a proper position, whether the cords be composed of one or more strands, or made in any other mode which is substantially the same, by which analogous results are produced."

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22. For an *Improvement in Moulding Hollow Ware;* William Rogers, Philadelphia, Pennsylvania, February 8.

Claim.—"Having described the manner in which I construct my patterns and flasks, for the moulding of tea kettles and other hollow ware of a like character, what I claim as my invention, and desire to secure by letters patent, is the forming of the patterns in the manner set forth, in their principal parts, there being a movable piece or disk in the bottom of the pattern, for the purpose of moulding the core on the anchor; which anchor, after the lower half of the kettle has been moulded, is unkeyed, and then keyed to the bar which crosses the mouth of the drag, for the purpose and in the manner described; the pattern and flask being, as a whole, constructed, and arranged, and combined as set forth."

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23. For an *Improvement in Machinery for Sanding Paper;* J. P. Gage, City of New York, February 15.

The patentee says,—"The nature of my invention consists in machinery for applying and affixing to the surface of paper, rough or angular pieces of glass, sand, crushed rock, or other like materials, and securing the same in a permanent manner to the said paper, which, when done, constitutes the article known as sand paper."

Claim.—"What I claim as my invention, and wish to secure by letters patent, is the second set of rollers for giving the finishing sizing, combined with the sanding table or hopper, and the first set of rollers, as set forth."

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24. For an *Improvement in Machinery for Making Brooms;* H. Warner, Cincinnati, Hamilton county, Ohio, February 15.

The patentee says,—"The nature of my invention consists in an apparatus for binding the broom corn firmly to the handle."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the following apparatus, namely, the peculiar arrangement of the ratchet wheel and its attached pulley; the apparatus for holding and pressing forward the handle; the apparatus for holding and regulating the wire or cord."

25. For an *Improvement in Stores, Counting Rooms, &c., for Preserving Property in case of Fire;* R. D. Curtiss, Erie, Pennsylvania, February 15.

The patentee says,—"My invention consists in providing offices, stores, store houses, &c., with door and railway, with the counting room shelves, counter, &c., and the springs, levers, bars, catches, pulleys, cylinders, chain, cords, &c., by which the whole is rendered, in case of fire, self-acting, for the purpose of removing goods, records, money, &c., out of the building."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the door and railway with the counting room shelves, &c., and the springs, levers, bars, cylinder, catches, chains, pulleys, cords, &c., by which the whole is rendered, in case of fire, self-acting, for the purpose of removing counting room shelves, &c., out of the building."

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26. For an *Improvement in Potato Planters;* Abraham Randel, Verona, Oneida county, New York, February 15.

The patentee says,—"The nature of my invention consists in constructing a drill barrow or plough on wheels, with suitable apparatus for making a furrow, dropping the seed, together with some stimulating manure, and covering them at the same time with ploughs or scrapers, which serve also for hilling the plants."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of distributing or taking the potatoes from the hopper, and dropping them, by the combination of the fingers placed at regular intervals round the cylinder, with the stationary fingers or grate in the bottom of the hopper, as set forth."

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27. For an *Improvement in Plates for Artificial Teeth;* Levi Gilbert, New Haven, Connecticut, February 15.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of atmospheric pressure to gold or other plates used in dentistry, the plate being single, of a smooth surface, and a chamber or cavity sunk in the central part of the upper surface of the plate, in which a vacuum can be readily formed by the use of the tongue as an air pump, constructed and operating as set forth."

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28. For an *Improvement in Washing Machines;* G. E. Roberts, Berkley Springs, Morgan county, Virginia, February 15.

The patentee says,—"The nature of my improvement consists in combining with a rectangular wash tub and fluted roller, a rocking concave of movable perforated and fluted parallel bars, sliding in grooves in the rockers, between which the clothes are held in such manner, that the portion of the clothes which require to be washed are brought between the fluted bars and the pressing roller, whilst the portion which merely requires a rinsing operation, are suspended below the bars immersed in the water, being agitated therein without any rubbing; at the same time that the fluted

rocking bars and fluted rolling presser are performing their operation of extracting the dirt from the soiled portions; the hot water and soap being forced to rise through the perforations in the bars, and to act on the clothes; the bars being held by a screw that passes through a fixed bar, at one end of the concave that bears against the movable bar next to it; all the bars being movable and acted on by said screw, except the one at the opposite end of the rockers from that at which the screw is placed."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of the rocking concave of fluted perforated slats, made in the manner described, and running upon horizontal parallel fixed ways, arranged in the bottom of the wash tub, in combination with a hollow weighted fluted roller, charged with water and placed upon the clothes in the rocking concave, the whole being arranged and operated in the manner and for the purpose set forth."

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29. For an *Improvement in Cooking Stoves;* Edwin Smith, Whitestown, Oneida county, New York, February 15.

The patentee says,—"The nature of my invention consists in having dampers so arranged as to enable the operator to guide or turn the heat either backward or forward, over, under, or around, either one or both of the ovens of the stove; or, by merely changing the position of the dampers, convert any of the passages for the fire and smoke into chambers of heated air, whenever the same may be required, thus increasing or decreasing the heat at pleasure, in either of the ovens, or parts of either of them. It also further consists in placing an iron plate an inch or two in front of the uppermost oven, and filling the space between such plate and the outside of the oven with ashes, to protect the oven from too severe action of the fire."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a sliding register, arranged at or near the back of the horizontal flues, between the two ovens, in combination with a stove of the above description, having a sliding damper next the smoke pipe, and a turning damper in the front flue beneath the hearth; said sliding register being operated in the manner set forth, causing the whole draught (when the register is partly drawn, and the upper damper is closed, and the front damper is open) to pass over the fire plate, and thence down to the centre of the stove, and thence partly around the large and small ovens, giving it a reverse draught around the large oven, and heating both ovens from the same point at the same time, and likewise, by closing the register, causing the whole draught to pass around the large oven and back of the small oven, to the pipe."

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30. For an *Improvement in Looms;* E. L. Norfolk, Salem, A. Marden, Newburyport, and Samuel L. Standley, Salem, Massachusetts, February 22.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is a combination composed of the following elements, or their mechanical equivalents, viz., 1st, The sheath and its cavities, applied to the side of the shuttle. 2d, The hooked rods or arms, (arranged within or

upon the arms,) and mechanism by which they are actuated in the manner specified. 3d, The said arms and mechanism applied to them, for the purpose of causing them to approach towards, and recede from, one another, in the manner described; the whole of the said combination of parts being made to operate the shuttle substantially as set forth, and for the purpose of doing away with the usual pickers, pickerstaffs, and straps, &c., such as are in common use, and which are liable to many serious objections, which are entirely overcome by our improvement."

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31. For an *Improvement in Machines for Roping Bales of Goods;* R. Dillon, City of New York, February 22.

The patentee says,—"The nature of my invention consists in providing machinery, to be operated by steam or other power, as an aid in roping up bales of cotton and other goods."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar combination of the sheaves with the ropes and tongs, applied for the purpose of roping up bales of goods in the manner herein set forth."

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32. For an *Improvement in Anti Friction Boxes and Axles;* J. Harris, Jr., Boston, Suffolk county, Massachusetts, February 22.

The patentee says,—"By my improved arrangement I use as few as five friction rollers, (but can use more or less,) and so gear them with the exterior periphery of the axle, and interior perimeter of the two halves of the box, as to keep the said rollers effectually apart from each other, without, by such arrangement, occasioning any appreciable friction."

Claim.—"What I claim as my invention, and desire to secure by letters patent, in friction roller boxes for shafting or gudgeons, is forming the spur gear teeth on the axle, several friction rollers, and interior of the box, and arranging them together substantially as set forth."

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33. For an *Improvement in Presses;* P. G. Gardiner, City of New York, February 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of guarding the screw against injury from lateral pressure, when there is a greater amount of power exerted at one end of the platen than at the other, by means of the combination of the nut and trunnions, and levers, with the guiding rollers and double ways, substantially as set forth."

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34. For an *Improvement in Making Sugar;* Charles de Manoel and E. Brafin, (assigned to Manoel, of Martinique, in the Republic of France,) February 22.

The patentees say,—"The nature of our invention consists in drying and pulverizing sugar cane, and then washing the saccharine matter therefrom, to be manufactured into sugar by evaporation in the ordinary way."

Claim.—"What we claim as new, and desire to secure by letters patent,

is extracting the sugar from the sugar cane, substantially in the manner described, by drying and pulverizing the cane, and then extracting the sugar by passing water through it, substantially as set forth."

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35. For an *Improvement in Spinning Machines;* Joseph Turner, Kensington, Philadelphia county, Pennsylvania, February 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is keeping the spindle bands at or near a uniform degree of tension, by causing the band cylinder to move alternately towards and from the bobbins, as they traverse vertically on the spindles, the bobbins on one side of the frame being at the middle of their traverse, whilst those on the opposite side are at the top or bottom of their traverse, whether these combined and reciprocal movements of the cylinder and bobbins be produced by the means before described, or any other substantially the same."

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36. For an *Improvement in Machinery for Splitting Leather;* Jonas P. Fairlamb, Wilmington, Newcastle county, Delaware, February 22.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the tappet wheels, tappet plate, and spring, for operating the knife."

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37. For an *Improvement in the Bench Vise;* Horace Wood, Troy, Rensselaer county, New York, February 22.

The patentee says,—"The nature of my invention consists in the application of a chain to the upright vise, whether made of wood or iron, so as to cause a parallel motion to the front jaw, and secure nearly the full power of the screw upon the article to be held."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is obtaining a parallel motion to the front jaw of upright bench vises, whether of wood or iron, by attaching a chain (or any other article which shall answer the purpose) to the front jaw close under the screw, and running it parallel with the screw through the back jaw, turning over a pulley down the back jaw, to the slide bar and around a second pulley, from thence parallel with the slide bar, to the end, and attaching it with a hook or otherwise to the end of said bar, for the purpose and in the manner described."

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38. For an *Improvement in the Bench Vise;* Jonathan Cowles, Belchertown, Hampshire county, Massachusetts, February 22.

The patentee says,—"The nature of my invention consists in combining with the vise a revolving arbor, with pinions at each end, which pinions are connected with, and play upon horizontal racks, being made fast at one end to the movable jaw of the vise, but sliding through the stationary jaw."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the screw and jaw, in combination with racks, pinions, and arbor."

39. For an *Improvement in Hot Air Furnaces;* Robert Hillson, Albany, New York, February 29.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, The grate, with a hemispherical or conical projection or bar rising upwards in the centre thereof, the part of the grate outside of said bars being flat, as an improvement upon former grates, which are either flat or hemispherical, or hemi-cylindrical, both the flat part and the projecting part of my grate being grated.

"Second, I do not claim the bed plates, nor do I claim a circular coal grate, or sifting grate, moving circularly in an opening made in the bed plate; but what I claim, is the use of the circular rim, which rests upon a circular opening in the bed plate, and moves circularly thereon, and upon which the grate hangs by pivots resting in sockets in the rim as described, as an improvement on the former mode, by which the grate rested by its sockets immediately on the bed plate.

"Third, I claim the manner of dumping the grate, by means of the cross-bars and handles, and the ways or projections for the cross-bars to move upon, the grate being suspended in the manner set forth.

"Fourth, I claim the separate air-chamber, constructed against the side of the lower cylinder, which may be extended to the top of the upper cylinder, for the purpose of heating an adjoining room.

"Fifth, I claim the connecting of the part of the furnace below the fire, by means of a continuous air passage and pipe, with the room to be heated, so as to draw from that room solely the air for the support of the fire, for the purpose of creating a draught into that room of the furnace as described.

"Sixth, I do not claim the cylindrical box or drum, called the hot air circular, nor do I claim the smoke circular; but I claim the combination of the smoke circular with this cylindrical box or drum, in the manner set forth."

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40. For an *Improvement in Seed Planting Machines;* Joshua Wood, Grafton, Grafton county, New Hampshire, February 29.

Claim.—"I claim as my invention, the combination of the dropping apparatus, the rotary pulverizing cylinder of knives, the main roller, and the rake in rear of the same; the same being arranged and operating together substantially in the manner set forth."

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41. For an *Improvement in the Reduction of Copper Ores;* James Napier, Middlesex county, Great Britain, February 29; (and patented in England, March 2, 1847.)

Claim.—"That which I claim as my invention, and desire to secure by letters patent, is the improvement in the smelting of copper ores, the same consisting in combining them in such manner, or with such materials, as will cause the gangue, or superfluous earthy matter, to be separated in a vitreous or glassy state, and afterwards treating them, under certain circumstances, substantially as described."

42. For an *Improvement in Pumps;* Elisha Barlow, Marietta, Worthington county, Ohio, February 29.

The patentee says,—"My pump consists of an outside case that is nearly triangular, and that contains within it a chamber of nearly the same form. The piston consists of a rectangular plate, hung on pivots at its upper end, and made to vibrate in the segment of a circle by means of a brake in the ordinary way."

Claim.—"What I claim as new, and desire to secure by letters patent, is the particular manner set forth, of arranging the clack valve, so that it shall serve equally to operate simultaneously in the sucking or raising the water, filling that section of the chamber from which it is moving, and forcing the water up from the opposite side of said chamber, as set forth."

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43. For an *Improvement in Window Blind Fasteners;* John Welsh, Washington city, D. C., February 29.

The patentee says,—"My improved apparatus for opening, and closing, and securing, shutters, consists of a sliding toothed rack, which is straight and passes through a mortise in the window frame, and of a toothed segment wheel or pinion, made fast to the bottom of the shutter or blind, in such manner as that its centre shall coincide with the centre of the joint pin of the hinge or hinges of the shutter. The sliding rack I provide with a hinge joint, by which it is enabled to fall down against the window frame, so as not to project into the apartment when the shutter is opened; it has, also, through it, a number of holes, into which a pin or bolt may be passed, to secure the shutter when opened or closed, or to hold it partially open at different distances. A pin, rising from the window sill and passing through the centre of the wheel, may constitute the lower hinge of the shutter, or, where the shutters have been already hinged, the toothed wheel or pinion, properly centered, may be made fast to the bottom of the shutter, the ordinary hinges both remaining in place."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner set forth, of employing a straight rack and a segment wheel, for the opening and closing of shutters, in combination with so constructing said rack, as that it may be turned down at the inside end in the manner made known, and that it may be made to hold the shutter in any desired position, by means of a bolt or pin as described."

Information to Persons having Business to Transact at the Patent Office.

In the Journal of the Franklin Institute, Vol. VII, 3d series, pages 301 and 375, we published the circular of the Commissioner of Patents, under the above title. Having just received another circular, recently issued, we lay before our readers the following corrections and additions, viz:—

Page 302.—*On the Application for a Patent.*

After Sec. 14, add, "In all cases in which the invention has been as-

signed before the issue of the patent, the correspondence should be in the name of the assignee, he being the party in interest."

Page 303.—*Description or Specification.*

To Sec. 18, add, "In case papers are withdrawn from the office for alteration or amendment before examination, the application will take its turn for examination as a new case filed on the day of the reception of the altered or amended papers."

Page 309.—*Fees Payable at the Patent Office.*

Sec. 41 is so changed as to read as follows:—"Every applicant must pay into the Treasury of the United States, or into the Patent Office, or to any of the Assistant Treasurers, Treasurers of the Mint and Branch Mints, Collectors and Surveyors of Customs, and Receivers of Public Money, particularly named in sec. 58, (see below,) a deposite to the credit of the Treasurer, on presenting his petition or application, as follows:"

After Sec. 50, add, "On application for a design, $15."

Sec. 55 altered to read, "After January 1, 1847, all fees sent to the Commissioner of Patents, should be transmitted in specie."

Sec. 56 altered to read, "It is recommended to make a deposite with the Assistant Treasurer, and other officers authorized to receive public moneys, of the fee for a patent or other application, and to remit the certificate. Where this cannot be done without much inconvenience, gold may be remitted by mail, at the risk of the applicant."

Sec. 57, Payment altered from "Deposit Bank," to "Assistant Treasurers, &c."

Sec. 58, Form altered from "Bank of," to "Office of the."

After Sec. 58, add—

"*Officers who are authorized to receive Patent fees on account of the Treasury of the United States, and to give receipts or certificates of deposite therefor.*

Assistant Treasurer of the U. S., Boston, Mass.	Collector, Mobile, Ala.
Assistant Treasurer " New York, N. Y.	Treasurer Branch Mint, New Orleans, La.
Treasurer of the Mint, Philadelphia, Pa.	Assistant Treasurer U. S., St. Louis, Mo.
Surveyor and Inspector, Pittsburg, Pa.	Surveyor of the Customs, Nashville, Tenn.
Ass't Treasurer of the U. S., Charleston, S. C.	Surveyor of the Customs, Cincinnati, Ohio.
Collector, Richmond, Va.	Receiver of Public Moneys, Little Rock, Ark.
Collector, Buffalo Creek, N. Y.	Receiver of Public Moneys, Jeffersonville, Ind.
Collector, Wilmington, N. C.	Receiver of Public Moneys, Chicago, Illinois.
Collector, Savannah, Ga.	Receiver of Public Moneys, Detroit, Mich.

"Any person wishing to pay a patent or other fee, may deposit it with either of the officers above named, and forward the receipt or certificate to this office, as evidence thereof.

"Money sent by the mail must be at the risk of the persons sending the same; and all moneys sent from the office, by mail, must be at the risk of the persons requesting to have it transmitted in that way. In no case should money be sent enclosed with models."

Page 311.—*Remedy in Equity for Patentees.*

After Sec. 63, add, "N. B. It has recently been decided in the District Court of Eastern Pennsylvania, that all proceedings in equity against the

Commissioner of Patents, must be commenced and prosecuted in the courts of the District of Columbia, no court out of the District having jurisdiction over the subject-matter."

Page 375.—*Exhibition of Models and Manufactures.*

Sec. 68, Erase the words "free of postage."

Page 377.—*Form of Oath.*

After Sec. 73, add, "A foreigner should specify of what country he is a citizen. An alien resident applying as a citizen, should make oath that he has been a resident in the United States one year next preceding his application for letters patent, and has made oath of his intention to become a citizen thereof."

Form of Withdrawal.

After Sec. 74, add, "N. B. If you withdraw your application, please enclose a receipt in following form:

"Received of the Treasurer of the United States, per Hon. Edmund Burke, Commissioner of Patents, twenty dollars, being the amount refunded on withdrawing my application for a patent for—"

Page 378.—*Form of Assignment of a Right in a Patent.*

After Sec. 76, add, "By the act of March —, 1848, the Commissioner of Patents is directed to charge fees for recording assignments, powers of attorney, licenses, &c., at the following rates, viz:

"On all assignments, &c., which shall not contain over 300 words, $1·00

"On all assignments, &c., containing more than 300 and not more than 1000 words, - - 2·00

"On all assignments containing more than 1000 words, - 3·00

"Which fees are, in all cases, *to be paid in advance.*

"The receipt of assignments is never acknowledged by the Office, but they are generally recorded in their turn, and transmitted to the persons entitled to them."

Page 384.—*Models.*

Sec. 84, Omit names of Collectors and Surveyors.

Read D. W. Pardee, Hartford, Conn., in place of P. Smith, Surveyor.

" Chas. T. Stewart, New Orleans, La., " T. G. Morgan, Collector.

After Sec. 84, add, "Agents must send models received by them by packet, when the same are forwarded at the expense of the office.

"If applicants prefer to have their models transmitted by express, instead of by packet, they must, in all cases, pay the expense of transportation."

Page 385, Strike out "*List of Banks authorized to receive Patent Fees.*"

ADDITIONAL INFORMATION IN NEW CIRCULAR.

Rules for taking and transmitting Evidence, &c., to the Commissioner of Patents.

PATENT OFFICE,

1st. That all statements, declarations, evidence, &c., shall be in writing, setting forth, minutely and particularly, the point or points at issue, and shall be verified by oath or affirmation.

2d. That all statements, declarations, proofs, and evidence, shall be filed in the Patent Office, by the parties, respectively, before the day of hearing.

3d. That before the deposition of a witness or witnesses be taken by either party, notice should be given to the opposite party of the time and place, when and where, such deposition or depositions will be taken; so that the opposite party, either in person or by attorney, shall have full opportunity to cross-examine the witness or witnesses. And such notice shall, *with proof of service of the same*, be attached to the deposition or depositions, whether the party cross-examine or not; and such notice shall be given in sufficient time for the appearance of the opposite party, and for the transmission of the evidence to the Patent Office before the day of hearing.

4th. That no evidence, statement, or declaration, touching the matter at issue, will be *considered* upon the said day of hearing, which shall not have been taken and filed in compliance with these rules: *Provided*, That if either party shall be unable, from good and sufficient reasons, to procure the testimony of a witness or witnesses, within the above stipulated time, then it shall be the duty of said party to give notice of the same to the Commissioner of Patents, accompanied with statements of the cause of such inability, which last mentioned notice to the Commissioner shall be received by him days previous to the day of hearing aforesaid, viz., the day of next.

5th. That all evidence, &c., shall be sealed up and addressed to the Commissioner of Patents, by the persons before whom it shall be taken, and so certified thereon.

6th. That the certificate of the magistrate taking the evidence shall be substantially in the following form, and written upon the envelope, viz:

"I hereby certify, that the depositions of A. B., C. D., &c., relating to the matter of interference between E. F. and G. H., were taken, sealed up, and addressed to the Commissioner of Patents, by me.

Justice of the Peace."

Extension of Patents.

PATENT OFFICE, *June* 1848.

The undersigned has adopted the following suggestions and rules, for the benefit of those persons who may hereafter apply for extensions:

The questions which arise on each application for an extension are—

1. Is the invention *novel*?
2. Is it *useful*?
3. Is it *valuable* and *important* to the public?
4. Has the inventor been *adequately remunerated* for his time and expenses in originating and perfecting it?
5. Has he used due diligence in introducing his invention into general use?

To enable the Commissioner to come to a correct conclusion in regard to the third point of inquiry, the applicant should, if possible, procure the testimony of persons disinterested in the invention, which testimony should be taken under oath.

In regard to the fourth and fifth points of inquiry, in addition to his own oath showing his receipts and expenditures on account of the invention, by which its value is to be ascertained, the applicant should show, by the testimony of disinterested witnesses on oath, that he has taken all reasonable measures to introduce his invention into general use, and that, without default or neglect on his part, he has failed to obtain from the use and sale of the invention, a reasonable remuneration for the time, ingenuity, and expense, bestowed on the same, and the introduction thereof into use.

The law now requiring that a notice of sixty days shall be given of each application for extension, it will be necessary for the applicant to file his petition, and pay in the requisite fee, at least three months before his patent expires.

In case of opposition by any person to the extension of a patent, both parties may take testimony, each giving reasonable notice to the other of the time and place of taking said testimony, which shall be taken according to the rules prescribed by the Commissioner of Patents in cases of interference.

All arguments submitted to the Commissioner must be in writing.

The report of the examiner, now required by law to be made to the undersigned, will, if practicable, be ready fifteen days before the day appointed for the hearing. And, in order that the examiner may have ample time to make his report, the patent, together with all the testimony and arguments, should be filed in the office at least twenty days before the day of hearing.

If the applicant fails to furnish the undersigned with a statement, *in detail*, of his receipts and expenditures, as required by the 18th section of the act approved July 4, 1836, his application must be rejected. His attention, therefore, is particularly called to this point, as many fail to accompany their petition with any statement of their receipts and expenditures.

In conclusion, the undersigned would remark, generally, that a monopoly of his invention is secured by law to the inventor for the term of fourteen years. This is done with a view to compensate him for his time and expense in originating and perfecting it. At the end of the time for which his patent runs his monopoly should cease, and the invention become public property, unless he can show good reasons to the contrary. The presumption is always against his application; and if he cannot show that his invention is novel, useful, valuable, and important to the public, and that, having made all reasonable effort to introduce it into general use, he has not been adequately remunerated for his time and expenses in discovering and perfecting it, the Commissioner cannot grant an extension.

EDMUND BURKE,
Commissioner of Patents.

Instructions to Patentees and others.

1. *Caveats.*—Caveat papers cannot, under *any circumstances*, be withdrawn from the office, nor undergo any alteration, after they have been once filed.

2. Additional papers relating to *the invention* may be admitted under the same file, the date of reception of such papers being noted.

3. In case of filing papers additional to an original caveat, the right to notice of such papers expires with the caveat; and any additional papers, not relating to the invention as first caveated, are not entitled to notice.

4. Caveat papers once filed, cannot be inspected by the caveator, nor any other persons than those duly authorized by law to examine such papers.

5. The caveator, or other person properly authorized by him, may at any time obtain copies of the caveat papers at the usual rates.

6. It is desirable that caveats should be explicit as to the character and features of the invention—embrace suitable drawings or sketches, and a model if convenient. The caveat fails of its purpose when the invention is not explained.

7. Models are always retained by the office.

8. Applications are examined in the order of their reception; except in cases in which the claims so nearly resemble those undergoing examination, as to render an interference probable; in which case they will be taken up and examined with the cases then under examination.

9. Rejected applications may be reconsidered at the request of the applicant, and explanations, whether verbal or in writing, may be at any convenient time received by the examiners; but final action upon such cases cannot be had until they come up in their turn as cases presented anew, except under peculiar circumstances, justifying a departure from the general rule.

10. In case specifications and drawings should be found defective, they are returned to the applicants with instructions to amend. When returned to the office they are again examined, the examination in such cases taking precedence of all new cases on hand at the time of their reception. But if, on such examination, it should be found that the instructions to amend have been disregarded, or not properly attended to, the papers are again returned to the applicant, and, upon their second return to the office, the examination of such papers is delayed until all the business on hand at the time of their reception is disposed of.

11. When papers are thus returned to applicants for amendments, should they find it necessary, or deem it important, to prepare a new document in order to make suitable amendments, *the original papers must be returned to the office, together with the amended or new papers*, otherwise examination upon such cases will be delayed until the original papers are received by the office.

12. After an application has been examined, no alteration made in the character of the invention can be considered under the same fee; but such alterations will require a separate fee, papers, &c., before examination can be had.

13. In general, if any addition is to be made to an invention duly before the office, or any change in its character, the applicant must withdraw and file his application anew.

14. All explanations or suggestions by Patent Agents, in relation to cases pending before the Office for examination, must be in writing, addressed to the Commissioner.

15. All patents will be delivered or sent by mail to the patentee, except

when a *written order* has been deposited by him in the Patent Office, directing the delivery to some other person.

16. When an application has been *finally decided*, the office will retain the original papers, allowing the applicant to obtain copies thereof.

EDMUND BURKE,
Commissioner of Patents.

Foreign Patents, Re-issues, and Additional Improvements.

Applications for inventions, *which have been patented* in a foreign country, will be taken up for examination immediately after all the necessary papers and drawings have been filed, the fee paid, and the model deposited in this office. As the letters patent issued in this country, for inventions patented abroad, bear date with the foreign letters patent, this rule has been adopted with the view of giving the longest term of time to the patent in this country. No invention will be considered as having been patented in a foreign country, unless the specification has been enrolled, and the patent in all respects complete.

For a similar reason, applications for the surrender and re-issue of letters patent, and for additional improvements to be added to original letters patent, will be examined immediately after they shall have been completed.

Patent Agents or Attorneys.

In this city, and in some of the other cities of the Union, individuals have undertaken the business of preparing applications, drawings, &c., for procuring patents, under the professional title of "Patent Agents," or "Patent Attorneys," from which circumstance many have supposed that such persons have some connexion with the Patent Office, official or confidential.

It has also come to the knowledge of the undersigned that some individuals, officiating in the character of Patent Agents, have pretended to possess an influence with the Patent Office not accorded to others, by which they are enabled to obtain patents in cases in which they have been refused to others. And also, that persons acting in the character of Patent Agents have charged the results of their own inattention, perhaps incompetency, to the negligence of the Patent Office.

These circumstances render it necessary for the undersigned to advise all persons having business with the Patent Office, of the precise relations which Patent Agents hold with this office.

The Patent Office recognizes no official or confidential relations with Patent Agents or Attorneys whatever. It does not concede to them any favors or privileges which are not granted to all other persons; and any pretensions to the contrary, (if any such are made,) are, of course, without foundation.

The only class of agents employed by the undersigned are those persons who have been authorized, in several of the cities of the Union, to receive and forward models, &c., to the Patent Office, and their connexion with the office begins and ends with that employment only. Their names and places of residence will be found on the 22d page of this pamphlet.*

*See Vol. VII, 3d series, p. 384, and the corrections in this Vol., p. 175.

This explanation is not made with any design to reflect upon such persons as have undertaken the business of Patent Agents in this city, or elsewhere, but only with the view of vindicating the Patent Office from any imputation which may grow out of the circumstances above alluded to, and of asserting the integrity and impartiality of its administration, which challenges and defies the most rigid scrutiny.

To relieve applicants from the necessity and expense of employing agents to transact their business with the Patent Office, so far as it is in the power of the office to do so, the examiners are instructed to decide the questions of the novelty and patentability of inventions upon papers imperfectly prepared, if they are sufficiently perspicuous to enable them clearly to understand the invention claimed, *when such papers are prepared by the inventor without the intervention of an agent.* But if an agent be employed, it being presumed that he is qualified for the business which he undertakes, and needs not, nor is entitled to, instructions in relation to it, the office (which has not the time, nor is bound by law in *any* case to give instruction) will, in all cases, leave it to him to prepare and present the claims of the applicant, and will decide upon them as they are presented.

Inventors, who are desirous of examining the models in the Patent Office before making application, should carefully avoid all persons hanging about the office and offering their services as agents, or to examine models; but they should, in all cases, apply to the Commissioner or chief clerk, who will direct the machinist to aid them in making a thorough examination of the models belonging to the class of inventions which they desire to see. This caution is given to enable inventors from abroad to avoid the misinformation and impositions to which they are exposed, from persons lying in wait for them about the Patent Office, and tendering their services as Patent Agents, or the procurers of Patent Agents. If the services of Patent Agents are desired, able and competent persons engaged in that business can be found *at their offices* in this city, and in other cities.

State of Business in the Patent Office.

The public are aware that, during the last two years, there has been a great increase of business in the Patent Office, amounting, in 1847, to *fifty per cent.* over the year 1845. While the undersigned has the power by law to increase the number of copying clerks, as the business of the office might require, he has no authority to make any addition to the examining corps, which is the most important branch of the service of the office.

At the first session of Congress, after his accession to the office of Commissioner of Patents, which was in 1845, in his annual report, he brought the embarrassed condition of the Patent Office to the attention of Congress, and requested an increase of the examining corps. He has since made four additional applications, setting forth particularly the condition of the office, growing out of a want of force to perform the duties and showing conclusively the absolute necessity of the employment of additional examiners.

Congress has at length acted upon the recommendations of the undersigned, and passed a bill authorizing the appointment of two additional

principal examiners, and two assistants, thus doubling that branch of the force of the office.

This addition to the Examining Corps, now provided for, will, it is believed, be sufficient to enable the office to perform all the duties devolving upon it at present. Yet it will be some months before the business in arrear will be brought up.

There are now over nine hundred applications on the files of the office to be examined. With the present force, it would require nine months to accomplish that amount of business. The additional number of examiners allowed by law, will enable the office to get through with it sooner. But, at best, it would take some months to bring up the business which is now so far in arrear.

EDMUND BURKE,
Commissioner of Patents.

SPECIFICATIONS OF ENGLISH PATENTS.

Abstract of MR. C. P. MANSFIELD'S *Patent Improvements in the Manufacture and Purification of Spirituous Substances and Oils, applicable to the purposes of Artificial Light and various useful arts, and in the application thereof to such purposes, and in the construction of lamps and burners applicable to the combustion of such substances.*—[Patent dated November 11, 1847.—Specification enrolled May 11, 1848.]

The specification of this patent is of extraordinary length; if given at length, it would fill a couple of our numbers, at least. For the following abstract of its multifarious contents, we are indebted to the learned patentee himself:

The invention is divided into five parts, which are respectively—

1st. An improvement in the manufacture of spirituous substances and oils.
2d. An improvement in the purification of spirituous substances and oils.
3d. An improvement in the application of spirituous substances and oils to the purposes of artificial light.
4th. An improvement in the construction of lamps.
5th. An improvement in the construction of burners.

The First Part is a method of separating from tars, bituminous matters, and empyreumatic oils, by distillation, hydrocarbons or spirituous substances, so volatile that they will yield sufficient vapor to a current of non-luminiferous gas or common air passed through them, to enable such gas or air to burn with a luminous flame; and further, an application to coal-tar, or to the substances distilled from coal-tar, of a knowledge of the different volatility of certain substances not hitherto separated from each other, which exist in the tar, so as to obtain certain distinct products; and in the further manufacture from certain of these products of a fragrant oil or oils.

The products thus manufactured are six; and for distinction are thus named—*alliole*, *benzole*, *toluole*, *camphole*, *mortuole*, and *nitro-benzole*.

Alliole is an extremely volatile fluid hydrocarbon, which is manufactured from coal-tar, or coal-naptha, by rectifying them in an apparatus similar to those used for the rectification of alcoholic spirits. It is applicable to all the purposes for which benzole may be used, but is more volatile.

Benzole is a hydrocarbon which boils at 176° Fah., being of the same volatility as spirit of wine. It is manufactured in the same manner as the alliole, by distilling a little further. For many purposes it is useful to receive these two fluids together. They are both excellent solvents of gutta percha, of India rubber, of wax, of grease and oils of all sorts, of mastic and many other resins, of copal and Animé, by exposing them to the vapor of the fluids, so that it shall condense upon the gums; of shell lac, by mixture with alcoholic or pyroxylic spirits; of camphor, sulphur, phosphorus, and many other substances. The solution of gutta percha or caoutchouc, or these mixed, when spread on a smooth surface, leaves on drying, which it does rapidly, a varnish, which may be peeled off in the form of a thin membrane; or, spread on the skin, forms an excellent plaster. They may be used as substitutes for ether in various pharmaceutical processes, and for many of the purposes to which alcohol is applied. Benzole, if inhaled, acts in the same way as chloroform and ether, in procuring insensibility to pain. It is applicable to the manufacture of perfume, as described under "nitro-benzole." Benzole and alliole form the part of coal-tar which is separated from it by treating in the manner proposed for bituminous matters in general; and, equally with such spirituous substances prepared from these other tars, is applicable to the production of vaporized air, in the manner described in the third part of the invention. It is also particularly applicable to the manufacture of fuel for vapor lamps, as described also in the third part.

Toluole is less volatile than benzole, and has nearly all the same properties as common rectified coal-naphtha; it consists of so much of the light coal-naphtha as remains after the separation of the benzole by rectification, and of the camphole, as described next. It is less volatile than benzole, and more volatile than oil of turpentine; and is applicable to all the purposes of the best coal-naphtha, when purified, as described in the second part of the invention.

Camphole is obtained by distilling off the toluole from the naphtha, and then rectifying the residue. The time when the receiver is to be changed is known by applying a lighted match to the surface of samples taken from the still-worm; when such samples no longer take fire on the surface, the camphole is collected, till the temperature in the retort has risen so high that solder melts on it, or till oil heavier than water distils over. This, when rectified, forms a substitute for camphine, and is useful as a solvent, when a very volatile fluid is not required. It is of nearly the same qualities as oil of turpentine.

Mortuole is prepared by rectifying the heavy or "dead oil" of tar, reserving what comes over between the temperatures about 330° Fah. and 500° Fah. When purified according to the method of part second, it forms a substitute for fixed oils in many purposes to which they are applied;

and, by mixture with spirit, as described in part three, forms an excellent lamp oil. It is also useful in making varnishes.

Nitro-benzole is a fragrant heavy oil, made by dissolving the light oils of coal-tar, for which rectified benzole is preferred, in strong nitric acid, and then diluting the acid with water, which separates the oil formed by the process. This oil is useful as a substitute for oil of bitter almonds in perfuming soap, or in flavoring confectionary, and has no poisonous properties.

The Second Part is a method of purifying and deodorizing bituminous and empyreumatic oils, which is partly applicable to such substances in general, and partly to some of the special substances manufactured according to the first part of the invention.

The agents used in deodorizing the empyreumatic oils are nitric and nitro-hydrochloric acids, or their salts, mixed with oil of vitriol, and alkaline leys, the oils being shaken with the acids and allowed to stand in vessels containing them, and then distilled. The purification of the oils with alkalies, which is particularly applicable to the less volatile fluids in coal-tar, particularly to that which is called "mortuole" in the specification, is conducted by digesting the oils with the alkaline solutions for a long time, at the boiling temperature of the solutions, in an apparatus consisting of a boiler or digester, surmounted by a head or condenser, in which all the vapors are liquified again and returned into the digester.

The fluid called benzole is purified in different methods according to the purpose for which it is required. If required for the purpose of illumination, it is purified by simply washing it with acids much diluted; if required for refined uses, it is purified by treatment with concentrated acids, as described for empyreumatic oils in general; and is then further treated by refrigeration, by which it is solidified; it is then, while solid, submitted to pressure at a low temperature, by which means it is obtained quite pure, and is now called "absolute benzole."

The Third Part concerns the application of volatile hydro-carbons, and other spirituous substances containing much carbon, to the purposes of artificial light, by mixing their vapor with such gases or vapors as contain little carbon, so as to produce a white light without smoke. This is accomplished in two methods. The first is that of passing a current of atmospheric air, or of hydrogen, carbonic oxide, or other non-luminiferous gases, through reservoirs to which hydro-carbons or spirituous substances are supplied, which contain so much carbon, and are so volatile, as to give off to the current of air so much vapor that the air shall be enabled to burn with a white flame, at a burner at a distance from the reservoir. The hydro-carbonous fluid preferred for this purpose is crude benzole, prepared from coal-naphtha. The current of air, if atmospheric air be used, is obtained by any known method of producing a continuous flow of air through pipes, such as by bellows or pumps, working into "gasometers;" and the system is applicable on a large scale, suited either to the lighting of houses or towns, or on a small scale, in which the whole apparatus may be comprised in a table-lamp. A table-lamp is also constructed, in which the flame is made to supply itself, by means of its own draught, with the vaporized air which is burned.

The other method, in which the reduction of carbon is effected, is by mixing the volatile hydrocarbons with spirits containing less carbon, such

as alcohol, or pyroxylic spirit, acetone, &c. Of these spirits, pyroxylic spirit is preferred on account of its cheapness; and different hydrocarbons are used according to the sort of lamp-fuel required. For vapor lamps, or portable gas lamps, such as are already in use on the Continent, for mixtures of alcohol and oil of turpentine, benzole is preferred on account of its volatility. For camphine lamps, or common Argand lamps, the "camphole" made from coal-tar is preferred. For coarser lamps, the "mortuole" or rectified dead oil is used in the mixture. All that is necessary is to obtain pyroxylic spirit sufficiently free from water to enable it to dissolve the oils, and then to mix them in the required proportions, and to keep the mixture so that the spirit shall not evaporate. The proportions best for vapor lamps are, two parts by measure of pyroxylic spirit to one part of coal-naphtha or benzole.

The Fourth Part relates to the manufacture of lamps for the combustion of the mixture of volatile hydrocarbons and spirits described in the third part. The improvement consists of forming a burner which is either supplied by a wick which fits it, or by a small quantity of fluid, kept at a constant level in the burner by pressure, so that the burner shall present a fine slit-orifice or jet for the escape of the vapor or gas, at which jet the vapor is to be ignited. These burners consist of two parts, a fixed wick-holder and a movable cap, by the adjustment of which the size of the jet-slit is regulated. The burners are of various forms, and admit of various modifications; the principle, which is exhibited in the drawings attached to the specification, forming the subject of the claim. This part of the invention comprises also the adaptation to the wick-holder of a cone within the reservoir, so as to cover that part of the wick which is above the fluid and below the wick-holder, and thus to prevent evaporation from the surface of the wick.

The Fifth Part consists of an improvement in the construction of gas burners, specially suited to the combustion of gas or air charged with the vapor of volatile hydrocarbons, according to the mode described in the third part, and also to the combustion of ordinary illuminating coal gas. The burners are such that the most perfect combustion and whiteness of the flame may be insured, by the adjustment of a movable part or parts of the burner. They admit of a variety of forms and constructions, and may be made as Argand burners or as single jets, drawings of several of which are attached to the specification. The principle in all is the same. One or more parts of the burner, which are caps made in the form of cones and cylinders, are made to be movable by the hand on a fixed part, so as to regulate with great nicety the size of the orifice from which the gas escapes; by this means altering the luminosity of the flame, which is more or less luminous according to the rapidity with which the vaporized air or gas is brought into contact with the surrounding air. Lond. Mec. Mag., July, 1848.

Extract from the Specification of the Patent granted to Charles Andre Felix Roçhaz, *of Paris, France, for certain Improvements in treating Zinc Ores, and in manufacturing Oxide of Zinc.*—[Sealed December 22, 1847.—Enrolled June, 1848.]

By this improved process, the employment of retorts is entirely dispensed

with, and the fuel and labor are greatly economized; the operation is also completely independent of the skill of the workman or attendant; and, lastly, the loss of metal incidental to the ordinary method is prevented. Besides these advantages, the patentee observes that ores of lead and zinc may both be operated upon at once by his improved method.

The principal feature of the invention consists in the reduction of roasted blend-ore, (native sulphuret of zinc,) and of the carbonates, oxides, or silicates of zinc, and also of the sulphurets and oxides of lead, by the action of the reducing gases of a blast furnace; by which the scoria or slag is fused, the reduced zinc volatilized, and the vapors condensed and conducted into a receiver of a peculiar form, situated over the mouth of the furnace, and heated by the gases therefrom. Lond. Jour. Arts, Sept. 1848.

Extract from the Specification of the Patent granted to WILLIAM NEWTON, *of the County of Middlesex, for certain Improvements in the Manufacture of Sugar from the Cane.*—[Sealed January 18, 1848.—Enrolled July, 1848.]

The cane or other substance containing saccharine matter, is first cut, (by a cane-cutter or other suitable apparatus,) into pieces of small size, and then dried in a proper stove or kiln, and afterwards pulverized. The process of drying the cane or other substance containing saccharine matter, after it has been cut up into slices or small pieces, may be conducted in any convenient and suitable manner, but it has been found advisable to place the sliced cane or other substance in a carrying apparatus, consisting of a rectangular metal frame, with a series of shelves placed one above another, and made of wire-work or perforated metal. This apparatus is termed by the inventor a carrying panier, and is suspended by chains from a carriage, which is made to run on a railway, so that the panier may, when loaded, be moved in or out of the kiln or stove, or chamber, through which a current of hot air is made constantly to pass. After the cane or other substance has been dried, it is to be pulverized in a suitable mill, and then submitted to the process about to be described.

This consists of a series of vats, the upper part of one communicating by a pipe with the bottom of that next adjoining. They are charged with the dried and ground cane. Water is let into the bottom of the first vat, through which it rises to the top, charging itself with saccharine matter, and flows off through the pipe into the bottom of the second vat, in which it rises in like manner. It thus passes through several tubs, until the solution reaches the density of 20° to 25° Baumé. It is drawn off and boiled down in the usual manner. Water pipes are so arranged as to let water into the bottom of each one separately. When, therefore, the cane in the first is exhausted, it is cut off from the series by stop-cocks, and water let into the second. The patent consists, first, in drying the cane, to render some of its organic matter insoluble, and thereby extract the sugar in a purer state; and secondly, in extracting the dried cane by the displacement process. Ibid.

Extract from the Specification of the Patent granted to FRANCIS WHISHAW, *of the County of Middlesex, for a certain Manufacture of Pipes of Earthenware, Pottery, and Glass, and of certain applications and arrangements thereof.*—[Sealed March 8, 1848.—Enrolled September, 1848.]

This invention has for its object to produce pipes of any convenient form, and suitable for the reception of the wires of electric telegraphs in a state of insulation, and for other purposes wherein a number of separate pipes or channels may be required, or wherein pipes of earthenware or pottery, of great uniformity of structure, and certain combinations of pipes of those materials and of glass, may be employed with advantage. It consists, firstly, in the formation of any required number of pipes, channels, or ducts, within one and the same mass or external surface of earthenware or pottery; the shape and arrangement of such pipes, channels, or ducts, and the form of the external surface, being adapted to the required circumstances. Secondly, in the mode of manufacturing pipes of earthenware or pottery, where pipes of peculiar uniformity of surface and consistency of material are required, whether as a cluster of pipes, channels, or ducts, within the same mass, or to be employed singly in the usual manner.—Thirdly, in certain combinations and arrangements of pipes of earthenware, pottery, and glass. Fourthly, in a certain mode of combining pipes of earthenware, pottery, and glass, so as to render them air-tight at the junctions.

Figure 2, above, is a vertical section, and figure 3 a plan view, of the ends of two pipes p, q, shaped and brought together as shewn, and united by means of liquid or semi-liquid cement, poured into the cavity r, and filling the grooved ring s, formed in halves in the ends of the pipes p, q,—a cement formed of asphalte or gutta percha is well adapted for the purpose. The joint thus formed will prevent the passage of air, gas, or other fluid, out of the main pipe. If preferred, the grooved ring may be made of any other form in the transverse section, (as, for example, the dovetail form represented at fig. 4.) Glass pipes may be connected by an air-tight joint, formed in the manner shewn at fig. 1, by making grooved rings in the collar o, and upon the ends of the pipes, and introducing cement into the same. Pipes connected by these air-tight joints will be suitable for every variety of speaking telegraph, hydraulic telegraph, and for gas and water pipes, and for other uses requiring an air-tight pipe or communication.

Ibid, Oct. 1848.

Extract from the Specification of the Patent granted to JOHN WATSON *and* EDWARD CART, *of Hull, for Improvements in the Manufacture of Gas.* [Sealed February 14, 1848.—Enrolled August, 1848.]

The object of this invention is to combine apparatus with an ordinary

hot air stove, for generating gas in proportion to the supply required; which is effected by so arranging the parts of the apparatus, that the supply of material (from which the gas is to be generated) to the retort will be gradually cut off as the gas-holder becomes filled; so that if the supply of gas be not consumed, the retort will not be fed with the material from which it is to be produced, and the generation of gas will consequently cease. Ibid.

Extract from the Specification of the Patent granted to HENRY VINT, *of Colchester, in the County of Essex, for his invention of Improvements in Propelling Ships and other Vessels.*—[Sealed September 6, 1847.—Enrolled March, 1848.]

These improvements in propelling ships and other vessels, consist in enclosing the paddle wheels, (of whatever construction,) in close chambers, on or in the sides of the vessel, with suitable shields on the outside of those chambers, formed by casings and curved guards; the whole of the propelling wheels, and the principal parts of the casings, being intended to be submerged or placed below the level of the water-line. Ibid.

Extract from the Specification of the Patent granted to CHARLES CRANE, *and* JAMES THOMAS JULLION, *of Stratford, Essex county, for Improvements in the Manufacture of Certain Acids and Salts, and a New Apparatus applicable to the said Improvements.*—[Sealed January 18, 1848 Enrolled July 18, 1848.]

First, as regards our improvements in the manufacture of certain acids, by which we mean nitric and oxalic acids, in a continuous mode or method of adding the materials, to be decomposed by degrees, as required, to the mother liquor, thus enabling us to employ a high temperature to the basic materials in the said manufacture. Likewise the conversion of the oxides of nitrogen into nitric acid, by the decomposition of water by means of chlorine.

A quantity of mother liquid being placed in the generator, and nitric acid and syrup, in the usual proportion to such quantity of mother liquor, placed separately in the feeding vessels, heat is to be applied, and the temperature of the liquor raised as quickly as possible to 180° or 200°.—Streams of nitric acid and syrup are then to be caused to flow, by turning the stop-cocks, through the funnel pipes into the liquor, in such quantity that the delivery of the whole shall occupy about 18 hours, at the expiration of which time the process will be completed. The gas or gases arising from the decomposition of the materials so supplied, will pass off through the eduction pipe into the receiver, where a stream of chlorine is to be introduced from the chlorine generator through a pipe, sufficient to convert the whole of the oxides of nitrogen into nitric acid. A portion of the water in the receiver will be decomposed, its oxygen combining with the oxide of nitrogen, to form nitric acid; while its hydrogen will combine with

the chlorine to form hydrochloric acid, their mixed vapor passing onward into the condensing vessels will there be condensed. The whole of the nitric acid and syrup having been run in, and the liberation of the gases or oxides of nitrogen having ceased, the liquor is to be drawn off from the generator, and placed in a convenient vessel to crystallize. Although we have described in the above process, the application of a temperature of from 180° to 200° as being that which we prefer, still, if it be thought desirable, the liquor may be heated even to the point of ebullition without detriment to the success of the process.

The second part of our invention, which relates to the manufacture of salts, consists, first, in manufacturing nitrates by means of the oxides of nitrogen and oxygen gas, or atmospheric air in conjunction with basic substances, as follows, namely, the oxides of nitrogen, however procured, are to be mixed with atmospheric air or oxygen gas, and made to pass through a chamber or other apparatus, containing a metal or metallic oxide, or any alkali or alkaline, with the presence of which basic substances induce a simultaneous combination of the oxide with oxygen, and the base thus employed to form a nitrate. For example, lime in the state of quicklime, hydrate, or carbonate, is to be placed in a chamber on trays, or in an apparatus similar to the "dry lime purifier" used in gas works, (or a series of the same,) and a current of the mixed gasses passed slowly through them; and when the gas that is given off from the last vessel is found to contain nitrous acid, the contents, which will be nitrate of lime, should be withdrawn, and the vessel replenished. We would here remark, that care should be taken to insure the presence of a sufficient quantity of atmospheric air or oxygen in the vessels so as to cause the entire conversion of the oxides of nitrogen to the highest degree of oxygenation, and their consequent combination with the basic substance as nitrate. The following mode of ascertaining this we have found sufficient for this purpose, namely, the absence of any of the oxides of nitrogen, together with the presence of free oxygen in the gas that issues from the last vessel, shows that sufficient oxygen has been furnished; on the contrary, should red fumes make their appearance upon allowing a portion of the gas to escape into the atmosphere, and which gases were previously colorless, it is a proof that there has been a deficiency of oxygen, and consequently more atmospheric air or oxygen gas must be passed into the apparatus. When a metal is employed in the place of lime, as above mentioned, we prefer to reduce it to small particles by granulation or otherwise, so as to expose a larger surface to the action of the mixed gases.

Secondly, we manufacture the tartrates of the alkaline earths by decomposing the tartrates of potash, by means of the sulphurets of the metallic basis of those earths. Of those we prefer either the sulphuret of calcium or the sulphuret of barium. For this purpose a solution of tartrate of potash is to be taken, and a solution either of sulphuret of calcium or sulphuret of barium added, until no further precipitation takes place, or either may be added in the solid state to the solution of the other, and boiled with occasional agitation, when tartrate of lime or baryta will separate, and sulphuret of potassium remain in solution. The solution should be examined by adding a solution of sulphuret of calcium, to ascertain whether the whole of the tartrate of potash is decomposed, taking care to have the sulphuret

in slight excess, so as to prevent loss of tartaric acid; or lime or baryta may be added to the solution of tartrate of potash and boiled, if preferred, and sulphuretted hydrogen passed into it, until no further precipitation takes place. When all the tartrate of potash is decomposed, the precipitate must be allowed to subside, and the clear solution of sulphuret of potassium withdrawn from off the precipitate, which must then be washed, to free it from adhering sulphuret of potassium, when it may be decomposed in the usual way for preparing tartaric acid, if that substance is required. When lime is used in conjunction with sulphuretted hydrogen for the decomposition, it may be used in the following proportions, viz., four parts of tartrate of potash to one part unslaked lime, as that quantity will be sufficient to decompose the solution of neutral tartrate arising from the decomposition by chalk of six parts of acid tartrate of potash.

Thirdly, we manufacture ammonia in the state of carbonate, hydrocyanate, or free ammonia, by passing any of the oxygen compounds of nitrogen, together with any compound of hydrogen and carbon, or any mixture of hydrogen with a compound of carbon, or even free hydrogen, through a tube or pipe containing any catalytic or contact substances as follows; the oxides of nitrogen, however procured, are to be mixed in such a proportion with any compound of carbon and hydrogen, or such mixture of hydrogen and carbonic oxide or acid, as results from the contact of the vapor of water with ignited carbonaceous matter, that the hydrogen compound, or mixture containing hydrogen, may be in slight excess, so as to insure the conversion of the whole of the nitrogen contained in the oxyde so employed into either ammonia or hydrocyanic acid, which may be known by the absence of the characteristic red fumes, upon allowing some of the gaseous matter to come in contact with atmospheric air. The catalytic or contact substance we prefer to employ is platinum, which may be either in the state of sponge, or asbestos, coated or covered with the platinum, may be substituted, which is to be placed in a tube which we prefer to heat to about 600° of Fahrenheit's thermometer. To this tube is to be attached a pipe of any convenient length, which is to pass through a vessel of water kept at the point of ebullition or thereabout, so as to reduce the temperature of the products, and at the same time prevent the deposition of carbonate of ammonia, which passes onwards into a vessel of the description well known and employed for the purpose of condensing carbonate of ammonia. This condenser, for our purpose, must be furnished with a safety pipe to allow of the escape of uncondensed matter, which should be made to dip into a solution of any substance capable of combining with hydrocyanic acid or ammonia, where they would be condensed. That which we prefer is a solution of a salt of iron, which condenses both hydrocyanic acid and ammonia, or a solution of hydrate of potash may be used if it be required to condense only the hydrocyanic acid; in the former case Prussian blue may be obtained, and in the latter ferrocyanate of potassium, by any of the usual and well known methods.

Lond. Rep. Pat. Inv., Sept. 1848.

MECHANICS, PHYSICS, AND CHEMISTRY.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculations of Steam Engines. By M. V. REGNAULT.

TENTH MEMOIR.

On the Specific Heat of Liquid Water at Different Temperatures.

(Continued from page 119.)

The experiments described in the preceding memoirs, were intended to determine the quantities of heat which it is necessary to give to 1 kilogramme (or one pound) of liquid water at 0°, to convert it into saturated steam under different pressures. But these quantities are composed of two parts; the first is the quantity of heat necessary to raise the temperature of the water from 0° to the degree at which the change takes place; and the second is that which is absorbed in the latent state by the passage of the liquid water to the state of vapor. Philosophers assume generally that the first portion is represented by the number which expresses the temperature of the steam; in other words, they assume that the calorific capacity of liquid water is constant: that is, that it requires the same quantity of heat to raise one kilogramme (or one pound) of water from 0° to 1°, as to raise it from 100° to 101°, or from 200° to 201°. M. Regnault has shewn, however, *(Ann. de Chimie et de Phys., 3e serie, tom.* IX, *p.* 324,*)* that the specific heat of certain liquids augments rapidly with the temperature. He found, in fact, that the mean specific heat of the oil of turpentine, which is about 0·420 between 15° and 20°, already becomes 0·467 between 20° and 100°. *(Ann. de Chimie, tom.* IX, *pp.* 342 *and* 347.*)* It is probable that increase of calorific capacity is especially very notable for liquids whose coefficient of dilatation is considerable, and that it increases rapidly with the temperature;—we ought, then, to expect to find a much less variation for water than for the oil of turpentine.

In a former memoir upon the specific heats of simple and compound bodies, *(Ann. de Chim. et de Phys., 2e serie, tom.* LXXIII, *p.* 35,*)* M. Regnault found for the mean specific heat of water between 15° and 100°, compared with that of the same liquid between 10° and 15°, (this latter being supposed 1·000,) the two numbers 1·00709 and 1·0089.

These numbers, though intended for another purpose, suffice to shew that the specific heat of water does not undergo any notable augmentation between 10° and 100°.

He now proposes to determine the same element up to the temperature 200°, (392° Fah.,) and for this purpose he devised the following mode of operating, which appears to him to be fitted to give accurate results.

The side of the boiler which was used in the experiments upon the elasticity of steam, was bored, and a tube was inserted, which, entering the boiler, bent down and extended to within 1 decim. (4 in.) of the bottom, where it opened into the boiler by a vertical opening. On the outside of the boiler, there was adjusted upon this tube a carefully made stop-cock,

having a clear passage of 10 mm. (0·4 in.) From the stop-cock proceeded a brass tube, which entered the side of a large vessel made of galvanized sheet iron, which was used as a calorimeter. The tube was closed at its extremity, but was pierced with a great number of small holes. The calorimeter had on its top a large tubulure, into which was cemented an open graduated glass tube. In another opening in the cover was cemented a very sensitive thermometer. Below, it had a stop-cock by which it could be completely emptied, and connected with it was a glass gauge-tube, by which the height of the water in the vessel could be, at any moment, accurately ascertained. It was also provided with a properly adjusted agitator, by which the water could be continually stirred, and was supported upon an iron tripod.

The tube passing from the boiler to the calorimeter, and the ring by which the calorimeter was supported upon its tripod, were carefully wrapped with woolen listing.

The calorimeter was placed as near the boiler as possible, and was protected from the radiant heat by a semi-cylindrical screen, formed of a tinned iron box, through which a stream of cold water was continually kept passing.

The weight of water which filled the calorimeter at different temperatures to the zero of the graduated glass tube, was carefully determined, and the value of each division of the tube ascertained.

The method of operating is as follows:

The boiler being filled about three-fourths full of water, it is put into communication with the air reservoir, and the pressure brought to about that corresponding to the temperature at which the experiment is to be made. The water is then made to boil, and when the boiler has arrived at uniformity of temperature, as indicated by its thermometers, the calorimeter is adjusted: that is to say, it is filled with water up to one of the divisions of the glass tube; the water is then agitated so as to give it an uniform temperature, and for five minutes the rise of temperature is carefully watched, for the purpose of ascertaining the corrections for the heating by the conducting power of the tube, and by contact with the surrounding air. A globe holding about 10 litres, (2·5 galls.,) is then placed under the stop-cock of the calorimeter, and nearly filled with water which is carefully weighed. As the weight of water originally placed in the apparatus was determined, the quantity remaining is perfectly known.

The temperature of the water in the calorimeter is now very carefully noted, and the stop-cock communicating with the boiler being then opened, the excess of pressure forces the hot water more or less rapidly into the calorimeter, and the calorimeter begins to fill again.

The height of the water is observed in the side gauge, and when it has risen nearly to the insertion of the graduated glass tube on top, the stop-cock is nearly closed and the water suffered to enter very slowly, to avoid overflow, until it has reached a proper point on the tube. The stop-cock is then entirely closed, and the water being all this time continually stirred, the thermometer is closely watched until it has attained a maximum temperature; the division of the glass tube to which the water rises is then immediately read. As the contents of the calorimeter have been already carefully gauged at all temperatures within the limits of the experiments,

the quantity of water which has entered from the boiler is known. The operation is very quick, especially at first, since $\frac{1}{20}$ths of the water enters during a half minute. Sometimes, in place of allowing the calorimeter to fill entirely from the boiler, the stop-cock was entirely closed when the water had risen nearly to the insertion of the tube, and the instrument was then filled by pouring into it a known quantity of water, at a known temperature. In either way, the quantity of water entering from the boiler became known.

The thermometer, after reaching a maximum, begins to fall, and is again watched for five minutes, for the purpose of getting the correction for the cooling by radiation, and by contact with air. This method gives all the data required for calculating the specific heat of water, between the temperature of the water in the boiler and the final temperature of the calorimeter.

A small correction is required for the mercurial column of the thermometer which projects above its cover.

The greatest cause of uncertainty arises from the difficulty of observing accurately the level of the water in the glass tube. As the water of the calorimeter becomes rapidly heated, it gives up the air which it held in solution. This air rises in bubbles, and the water has to be stirred for a long time, to be certain that they are entirely discharged and do not alter the level in the glass tube.

Experiments, given at the end of the memoir on "The Compressibility of Liquids," (vol. xvi, p. 334,) make it extremely probable that any heat absorbed by the water, in its sudden expansion from the pressure of the boiler to that of the atmosphere, in entering the calorimeter, may be entirely negligable.

M. Regnault then gives a table of his experiments, from which it appears that the specific heat of water from 0° to 30° (32° to 86° F.) being 1000,
" 30° to 110° (86° to 230° F.) it is 1005,
and " 30° to 190° (86° to 374° F.) it is 1015.

The increase is, therefore, so very small, that in most cases it may be neglected, especially if the heat does not surpass 100°. (212° F.)

M. Regnault then calculates a formula of interpolation of the form

$$Q = T + AT^2 + BT^3$$

where Q = the number of units of heat which a kilogramme of water, heated to a temperature T, abandons, in cooling to 0°. The unit of heat being the quantity of heat which 1 kilogramme of water at 0° absorbs in rising 1° in temperature.

From his experiments, he calculates the constants A & B, and the formula becomes

$$Q = T + 0{\cdot}00002T^2 + 0{\cdot}0000003T^3.$$

The quantity of heat which a quantity of water, at the temperature T, absorbs in rising 1° of temperature is given by the formula,

$$\frac{dQ}{dT} = 1 + 0{\cdot}00004T + 0{\cdot}0000009T^2.$$

By means of these formulæ the following table was calculated, giving for every ten degrees of temperature Centigrade, as noted by the air thermometer, the quantities of heat (Q) which a kilogramme (or pound) of

water, heated to the temperature T, gives out in descending to 0°, and the quantities of heat which a kilogramme (or pound) of water at T°, absorbs when its temperature becomes $(T+dT)°$.

If from the total quantities of heat which a kilogramme of saturated steam at T°, abandons in passing to the condition of liquid water at 0°, (quantities which are given in the table below,) we subtract the quantities (Q) of heat which a kilogramme of liquid water at T°, abandons in descending to 0°, we shall obtain the quantities of heat which a kilogramme of saturated steam, at the temperature T°, abandons in passing to the state of liquid water at the same temperature. These latter quantities, which are commonly called the *latent heats* of steam, we give in the last column of the table.

Table of the Specific Heats of Liquid Water.

Temperature by the Air Thermometer.		Number of units of heat abandoned by a kilogramme of water in descending from T° to 0°. Q.	Mean specific heat of water between 0° and T°.	Specific heat of water between T and T+dT. $\frac{dQ}{dT}$.	Latent heat of saturated steam at the temperature T.
Fahr.	Cent. (T).				
32°	0°	0·000	...	1·0000	606·5
50	10	10·002	1·0002	1·0005	599·5
68	20	20·010	1·0005	1·0012	592·6
86	30	30·026	1·0009	1·0020	585·7
104	40	40·051	1·0013	1·0030	578·7
122	50	50·087	1·0017	1·0042	571·6
140	60	60·137	1·0023	1·0056	564·7
158	70	70·210	1·0030	1·0072	557·6
176	80	80·289	1·0035	1·0089	550·6
194	90	90·371	1·0042	1·0109	543·5
212	100	100·000	1·0050	1·0130	536·5
230	110	110·641	1·0058	1·0153	529·4
248	120	120·806	1·0067	1·0177	522·3
266	130	130·997	1·0076	1·0204	515·1
284	140	141·215	1·0087	1·0232	508·0
302	150	151·462	1·0097	1·0262	500·7
320	160	161·741	1·0109	1·0294	493·6
338	170	172·052	1·0121	1·0328	486·2
356	180	182·398	1·0133	1·0364	479·0
374	190	192·779	1·0146	1·0401	471·6
392	200	203·200	1·0160	1·0440	464·3
410	210	213·660	1·0174	1·0481	456·8
428	220	224·162	1·0189	1·0524	449·4
446	230	234·708	1·0204	1·0568	441·9

The Atmosphere.

The atmosphere rises above us with its cathedral dome arching towards the heaven of which it is the most familiar synonyme and symbol. It floats around us like that grand object which the Apostle John saw in his vision: "a sea of glass like unto crystal." So massive is it that, when it begins to stir, it tosses about great ships like playthings, and sweeps cities and forests like snow flakes to destruction before it. And yet it is so mobile, that we have lived years in it before we can be persuaded it exists at all,

and the great bulk of mankind never realize the truth that they are bathed in an ocean of air. Its weight is so enormous that iron shivers before it like glass, yet a soap-ball sails through it with impunity, and the tiniest insect waves it with its wings. It ministers lavishly to all the senses.—We touch it not, but it touches us: its warm south wind brings back color to the pale face of the invalid: its cool west winds refresh the fevered brow, and make the blood mantle in our cheeks: even its north blasts brace into new vigor the hardened children of our rugged clime. The eye is indebted to it for all the magnificence of sunrise, the full brightness of mid-day, the chastened radiance of the gloaming, and the clouds that cradle near the setting sun. But for it the rainbow would want its triumphal arch, and the winds would not send their fleecy messengers on errands round the heavens. The cold ether would not shed its snow feathers on the earth, nor would drops of dew gather on the flowers. The kindly rain would never fall—hail, storm, nor fog diversify the face of the sky. Our naked globe would turn its tanned unshadowed forehead to the sun, and one dreary monotonous blaze of light and heat dazzle and burn up all things. Were there no atmosphere, the evening sun would in a moment set, and, without warning, plunge the earth in darkness. But the air keeps in her hand a sheaf of his rays, and lets them slip but slowly through her fingers; so that the shadows of evening gather by degrees, and the flowers have time to bow their heads, and each creature space to find a place of rest and nestle to repose. In the morning the garish sun would, at one bound, burst from the bosom of night and blaze above the horizon; but the air watches for his coming, and sends at first but one little ray to announce his approach, and then another, and by and by a handful,—and so gently draws aside the curtain of night, and slowly lets the light fall on the face of the sleeping earth, till her eye-lids open, and, like man, she goeth forth again to her labor until the evening.—*Quarterly Review.*

Lond. Athen., Dec. 1848.

On the Crystalline Polarity of Bismuth and other bodies, and on its Relation to the Magnetic Form of Force. From the Bakerian Lecture delivered before the Royal Society, London, by Dr. Faraday.

The author states that in preparing small cylinders of bismuth, by casting them in glass tubes, he had often been embarrassed by the anomalous magnetic results which they gave, and that having determined to investigate the matter closely, it ended in a reference of the effects to the crystalline condition of the bismuth, which may be thus briefly stated.

If bismuth be crystallized in the ordinary way, and then a crystal, or a group of symmetric crystals, be selected and suspended in the magnetic field between horizontal poles, it immediately either points in a given direction or vibrates about that position, as a small magnetic needle would do, and if disturbed from this position it returns to it. On re-suspending the crystal so that the horizontal line which is transverse to the magnetic axis shall become the vertical line, the crystal then points with its maximum degree of force. If it be again re-suspended, so that the line parallel to the magnetic axis be rendered vertical, the crystal loses all directive

force. This line of direction, therefore, which tends to place itself parallel to the magnetic axis, the author calls the *magne-crystallic axis* of the crystal. It is perpendicular, or nearly so, to the brightest and most perfect of the four cleavage planes of the crystal. It is the same for all crystals of bismuth. Whether this magne-crystallic axis is parallel or transverse to the magnetic axis, the bismuth is in both cases repelled from a single or the stronger pole; its diamagnetic relations being in no way affected. If the crystal be broken up, or if it be fused and re-solidified, and the metal then subjected to the action of the magnet, the diamagnetic phenomena remain, but the magne-crystallic results disappear, because of the confused and opposing crystalline condition of the various parts. If an ingot of bismuth be broken up and fragmentary plates selected which are crystallized uniformly throughout, these also point; the magne-crystallic axis being, as before, perpendicular to the chief plane of cleavage, and the external form, in this respect, of no consequence. The effect takes place when the crystal is surrounded by masses of bismuth, or when it is immersed in water or solution of sulphate of iron, and with as much force apparently as if nothing intervened. The position of the crystal in the magnetic field is affected by the approximation of extra magnets or of soft iron; but the author does not believe that this results from any attractive or repulsive force exerted on the bismuth, but only from the disturbance of the lines of force or resultants of magnetic action, by which they acquire, as it were, new forms; and, as the law of action which he gives is, that *the line or axis of magne-crystallic force tends to place itself parallel, or as a tangent, to the magnetic curve or line of magnetic force, passing through the place where the crystal is situated*, so the crystal changes its position with any change of direction in these lines.

After noticing the magne-crystallic condition of various bodies, the author enters upon a consideration *of the nature of the magne-crystallic force*. In the first place he examines closely whether a crystal of bismuth has exactly the same amount of repulsion, diamagnetic or otherwise, when presenting its magne-crystallic axis *parallel* or *transverse* to the lines of magnetic force acting on it. For this purpose, the crystal was suspended either from a torsion balance, or as a pendulum thirty feet in length, but whatever the position of the magne-crystallic axis, the amount of repulsion was the same.

In other experiments, a vertical axis was constructed of cocoon silk, and the body to be examined was attached at right angles to it as radius; a prismatic crystal of sulphate of iron, for instance, whose length was four times its breadth, was fixed on the axis with its length as radius and its magne-crystallic axis horizontal, and therefore as tangent; then, when this crystal was at rest under the torsion force of the axis, an electro-magnetic pole with a conical termination was so placed that the axial line of magnetic force should be, when exerted, oblique to both the length and the magne-crystallic axis of the crystal; and the consequence was, that, when the electric current circulated round the magnet, the crystal actually *receded* from the magnet under the influence of the force, which tended to place the magne-crystallic axis and the magnetic axis parallel.

Employing a crystal or plate of bismuth, that body could be made to *approach* the magnetic pole under the influence of the magne-crystallic

force; and this force is so strong as to counteract either the tendency of the magnetic body to approach, or of the diamagnetic body to retreat, when it is exerted in the contrary direction. Hence the author concludes that it is neither attraction nor repulsion which causes the set, or determines the final position of a magne-crystallic body.

He next considers it as a force dependent upon the crystalline condition of the body, and therefore associated with the original molecular forces of the matter. He shows experimentally, that, as the magnet can move a crystal, so also a crystal can move a magnet. Also, that heat takes away this power just before the crystal fuses, and that cooling restores it in its original direction.

He next considers whether the effects are due to a force altogether original and inherent in the crystal, or whether that which appears in it is not partly induced by the magnetic and electric forces; and he concludes, that the force manifested in the magnetic field, which appears by external actions and causes the motion of the mass, is chiefly, and almost entirely *induced*, in a manner subject indeed to the crystalline force and additive to it, but at the same time exalting the force and the effects to a degree which they could not have approached without the induction. To this part of the force he applies the word *magneto-crystallic*, in contradistinction to magne-crystallic, which is employed to express the condition or quality or power which belongs essentially to the crystal.

The author then remarks upon the extraordinary character of the power, which he cannot refer to polarity, and gives expression to certain considerations and views, which will be best learned from the paper itself. After this, he resumes the consideration of Plucker's results "*upon the repulsion of the optic axes of crystals*," already referred to, and arrives at the conclusion that his results and those now described have one common origin and cause. He then considers Plucker's results in relation to those which he formerly obtained with heavy optical glass and many other bodies.

In conclusion he remarks, "how rapidly the knowledge of molecular forces grows upon us, and how strikingly every investigation tends to develope more and more their importance and their extreme attraction as an object of study. A few years ago magnetism was to us an occult power, affecting only a few bodies; now it is found to influence all bodies, and to possess the most intimate relations with electricity, heat, chemical action, light, crystallization, and, through it, with the forces concerned in cohesion; and we may, in the present state of things, well feel urged to continue in our labors, encouraged by the hope of bringing it into a bond of union with gravity itself." Ibid.

Enormous Application of the Electrotype Process.

An enormous application of the electrotype, or galvano-plastic process, has been made in the sculpture of the Cathedral of St. Isaac, at St. Petersburgh, by the architect. After having made very important experiments, he was authorized to adopt this mode in the execution of the metallic sculptures and carvings for the following reasons: 1. The identical reproduction of the sculpture without chiselling. 2. The lightness of the pieces, which

enabled the architect to introduce sculptures of higher relief than any hitherto known, and to fix the pieces suspended from the vaultings, without fear of accident, or of their being detached. 3. The great saving of expense between these and castings in bronze. The gilding, also, was effected by the same process, and presented equal advantages. The seven doors of the cathedral will be of bronze and electrotype, the framework being of the former, and the sculptural parts of the latter. Three of these doors are 30 feet high, and 14 feet wide, the four others 17 feet 8 inches wide. They contain 51 bas-reliefs, 63 statues, and 84 alto-relievo busts, of religious subjects and characters. The quantity of metal employed in the dome is as follows: Ducat gold, 247 lbs.; copper, 52½ tons; brass, 321½ tons; wrought iron, 524½ tons; cast iron, 1068 tons. Total, 1966½ tons.—*Builder.*

Ibid.

How to Harden Gypsum.

It is known that calcined gypsum, after being moistened with a solution of alum and again burnt, acquires much greater hardness and solidity.—M. Kreating recommends for the same purpose a solution of 1 lb. of borax in 9 lbs. of water, which is poured over the calcined fragments of gypsum. They are then kept at a strong red heat for six hours, ground to a powder and worked. The effect is said to be still better, if a pound of tartar and twice the quantity of water are added to the solution.—*Liebig's Annalen*

Lond. Chem. Gaz., July 1848.

Ultimate Analysis of some varieties of Coal. *By* Fred. Vaux, Esq.

The following analyses of several important species of coal, were undertaken in the laboratory of King's College, for the purpose of ascertaining their ultimate composition, as well as the nature of the ashes obtained from each.

The varieties of coal subjected to examination, with the respective localities from whence they were obtained, are as follows:

1. Newcastle caking coal, as ordinarily used in the laboratory.
2. Wigan cannel coal, specimen obtained from Professor Miller.
3. Coal from St. Helen's, Lancashire, (Rushey Park seam,) specimen also from Professor Miller.
4. Staffordshire coal, sample taken last Christmas from the ten-yard seam of a mine near Wolverhampton.
5. Sample from the bottom of the above-named seam in the same mine.
6. Coal from the top of a bed in the Oregon territory.
7. Anthracite, (Welsh.)
8. Bovey coal, or lignite, from Bovey Heathfield, Chudleigh, near Exeter, Devon.
9. Peat, cut for fuel in 1847, from the neighborhood of the Military Prison, Princetown, near Tavistock, on the Forest of Dartmoor, Devon.

TABLE I.—*Relative Proportions in* 100 *parts of Undried Coal.*

	Newcastle.	Wigan Cannel.	St. Helen's.	Stafford.	Stafford, Bottom of Seam.	Oregon.	Anthracite.	Bovey.	Peat.
Specific Gravity, . .	1·2760	1·2760	1·2790	1·2785	1·2760	1·5780	1·3925	1·1290	0·8495
Water, ...	1·3550	0·6060	3·2325	11·2910	8·3910	5·6245	2·0000	34·6600	25·5650
Gaseous matter, . .	31·9450	38·7310	31·2675	31·4990	33·4090	27·8755	5·9000	34·6310	45·1300
Coke, ...	66·7000	60·3630	65·5000	57·2100	58·2000	66·5000	92·1000	30·7090	29·3050
Ash, ...	2·0400	2·6730	5·0000	0·9125	2·7600	33·5000	1·5830	1·4790	7·2450
Sulphur, ...	0·7368	1·4844	0·8728	0·3450	2·3534	— —	0·8967	1·5446	0·4168
Nitrogen, ...	2·0212	2·1037	1·8642	1·6326	—		0·8111	0·3691	1·7123

TABLE II.—*Relative Proportions in a ton of Undried Coal.*

	Newcastle.	Wigan Cannel.	St. Helen's.	Stafford.	Stafford, Bottom of Seam.	Oregon.	Anthracite.	Bovey.	Peat.
	c. qr. lb.	c. qr. lb.	c. qr. lb.	c. qr. lb.	c. qr. lb.	c. qr. lb.	c. qr. lb.	c. qr. lb.	c. qr. lb.
Water, ...	0.1. 24	0.0.20¼	0.2.16½	2.1. 1	1.2.20	1.0.14	0.1.16¾	6.3.20¼	5.0.12½
Coke, ...	13.1.10	12.0. 8¼	13.0.11¼	11.1.21½	11.2.15½	13.1. 5½	18.1.19	6.0.15¾	5.3.12½
Gaseous matters, . .	6.1.15¾	7.2.27½	6.1. 0¼	6.1. 5½	6.2.20¾	5.2. 8½	1.0.20¼	6.3.20	9.0. 3
Sulphate of ammonia,*	2.0.18½	2.1. 0¼	1.3.27	1.3. 0	—	—	0.3.13¼	0.1.16¼	1.3. 9½
Ash, ...	0.1.17½	0.2. 3¾	1.0. 0	0.0.20½	0.2. 5¾	6.2.22½	0.1. 7½	0.1. 5¼	1.1.22½
Sulphur, ...	0.0.16½	0.1. 5¼	0.0.19½	0.0. 7¾	0.1.24¾	—	0.0.20	0.1. 6½	0.0. 9¼

* Calculated on the supposition that the whole of the nitrogen is converted into ammonia, which, in practice, is not the case.

TABLE III.—*Relative Proportions in* 100 *parts of Dried Coal.*

	Newcastle.	Wigan Cannel.	St. Helen's.	Stafford.	Stafford, Bottom of Seam.	Oregon.	Anthracite.	Bovey.	Peat.
Carbon,	81·4110	80·0685	75·8050	78·5670	—	—	90·3905	66·3140	54·0235
Hydrogen,	5·8275	5·5265	5·2170	5·2910	—	—	3·2830	5·6270	5·2120
Oxygen,	7·8975	8·0870	11·9825	12·8845	—	—	2·9688	22·8610	28·1710
Nitrogen,	2·0490	2·1230	1·9265	1·8405	—	—	0·8277	0·5650	2·3005
Ash,	2·0680	2·6970	5·1670	1·0280	3·0110	35·4960	1·6150	2·2690	9·7330
Sulphur,	0·7470	1·4980	0·9020	0·3890	2·5690	—	0·9150	2·3640	0·5600

TABLE IV.—*Relative Proportions in* 100 *parts of Coal, free from water and ash.*

	Newcastle.	Wigan Cannel.	St. Helen's.	Stafford.	Stafford, Bottom of Seam.	Oregon.	Anthracite.	Bovey.	Peat.
Carbon,	83·1301	82·2878	79·9352	79·3830	—	—	91·8742	67·8535	59·7377
Hydrogen,	5·9505	5·6796	5·5012	5·3459	—	—	3·3368	5·7576	5·7739
Oxygen,	8·0647	8·3113	11·5811	13·0185	—	—	3·0178	23·3920	31·3196
Nitrogen,	2.0920	2·1818	2·0314	1·8596	—	—	0·8412	0·5781	2·5485
Sulphur,	0·7627	1·5395	0·9511	0·3930	2·6487	—	0·9300	2·4188	0·6203

The following table gives the calculated results on the annexed approximative empirical formulæ for each of the preceding varieties of coal, at the same time exhibiting their agreement with the quantities of carbon, hydrogen, and oxygen, found by analysis in Table IV.

	Newcastle. $C_{27}H_{11}O_2$		Wigan Cannel. $C_{26}H_{10}O_2$		St. Helen's. $C_{28}H_{11}O_3$		Stafford. $C_{26}H_{10}O_3$	
Formula.	Calc'd.	Found.	Calc'd.	Found.	Calc'd.	Found.	Calc'd.	Found.
Carbon, . . .	83·260	83·1301	82·520	82·2878	80·280	79·9350	80·250	79·3830
Hydrogen, . .	5·654	5·9505	5·289	5·6796	5·256	5·5012	5·144	5·3459
Oxygen, . .	8·223	8·0647	8·463	8·3113	11·470	11·5811	12·348	13·0180

	Anthracite. $C_{40}H_8O$		Bovey. $C_{27}H_{14}O_7$		Peat. $C_{20}H_{11}O_8$	
Formula.	Calc'd.	Found.	Calc'd.	Found.	Calc'd.	Found.
Carbon, ...	92·080	91·8740	67·730	67·8535	59·580	59·7377
Hydrogen, ...	3·069	3·3368	5·853	5·7576	5·462	5·7739
Oxygen, ...	3·069	3·0178	23·412	23·3920	31·780	31·3196

On the Analyses of some Specimens of Hot and Cold Blast Iron. *By* F. C. WRIGHTSON, ESQ.

The specimens of iron of which the following are analyses, were kindly furnished by Richard Smith, Esq., agent to Lord Ward, from the Coneygre iron furnaces, near Dudley. The object of the analyses was to show how far the quality agrees with what might be predicated from the composition, and also the difference produced in the composition of the iron

by the cold, warm, and hot blasts respectively, when smelted from the same, or nearly the same, materials. The materials manufactured by the hot blast only differed in having a small proportion of an ore richer in iron added to the others; and it is probable that the essential difference in the per centage of silica contained in two, and of the phosphorus in all, is due to the effect of the hot blast. The phosphoric acid, for example, requiring a very high temperature for its reduction. Of Nos. 2 and 4, (see table below,) the *hot blast* iron is considered much inferior, being more brittle than the others, and requiring much longer working in the puddling furnace. No. 8 (hot blast) is also considered a very inferior iron, for, although it contains but little silica, a larger proportion of phosphorus enters into its composition. This, however, as well as the warm and cold blast of the same number, is liked by the workmen, (puddlers,) on account of the yield, they being paid by the quantity produced; and this, as will readily be seen, must be greater than from the lower numbers.

Analysis of 12 *specimens of "Cast Iron from the Furnace;" three kinds, "Cold," "Warm," and "Hot Blast;" 4 qualities of each*, 2, 4, 6, 8.

COLD BLAST.

2.		4.		6.		8.	
Silica, .	3·51	Silica, .	3·45	Silica, .	1·79	Silica, .	1·37
Iron, .	92·98	Iron, .	90·61	Iron, .	93·53	Iron, .	95·67
Manganese .	0·49	Manganese,	0·91	Manganese,	0·95	Manganese,	0·35
Sulphur, .	0·99	Sulphur, .	0·30	Sulphur, .	0·39	Sulphur, .	0·36
Phosphorus,	0·47	Phosphorus,	0·41	Phosphorus,	0·31	Phosphorus,	0·20
Nitrogen, .	—	Nitrogen, .	—	Nitrogen, .	0·25	Nitrogen, .	—
Carbon, .	2·31	Carbon, .	2·19	Carbon, .	2·04	Carbon, .	1·79
	100·75		97·87		99·26		99·74

WARM BLAST.

Silica, .	3·09	Silica, .	2·89	Silica, .	1·33	Silica, .	1·57
Iron, .	92·45	Iron, .	91·82	Iron, .	94·20	Iron, .	95·08
Manganese,	0·54	Manganese,	0·91	Manganese,	0·50	Manganese,	0·79
Sulphur, .	0·57	Sulphur, .	0·26	Sulphur, .	0·20	Sulphur, .	0·45
Phosphorus,	0·40	Phosphorus,	lost.	Phosphorus,	0·54	Phosphorus,	0·38
Nitrogen, .	—	Nitrogen,	—	Nitrogen,	—	Nitrogen,	—
Carbon, .	1·96	Carbon, .	2·76	Carbon, .	2·11	Carbon, .	2·28
	99·01		98·64		98·88		100·55

HOT BLAST.

Silica, .	5·14	Silica, .	5·06	Silica, .	1·57	Silica, .	1·34
Iron, .	90·76	Iron, .	91·30	Iron, .	94·31	Iron, .	95·64
Manganese,	0·79	Manganese,	0·69	Manganese,	0·79	Manganese,	0·39
Sulphur, .	1·07	Sulphur, .	0·28	Sulphur, .	0·20	Sulphur, .	0·33
Phosphorus,	0·51	Phosphorus,	0·55	Phosphorus,	0·50	Phosphorus,	0·71
Nitrogen, .	trace.	Nitrogen, .	—	Nitrogen, .	—	Nitrogen, .	0·10
Carbon, .	2·87	Carbon, .	2·09	Carbon, .	1·82	Carbon, .	1·59
	101·14		99·97		99·19		100·10

Ibid.

On the Formation of Hydraulic Limestones, Cements, and other Minerals, in the Moist Way. By PROF. KUHLMANN.

The author had some time ago observed that all limestones contain small quantities of alkalies; and he has recently found that, in hydraulic limestones in particular, a very considerable amount of potash occurs.—From this he concluded that the silicate of potash must exercise an essential influence upon the production of cements; and he succeeded in producing artificially hydraulic limestone in the moist way, by mixing lime with silica or alumina dissolved in water containing some potash. When powdered chalk is employed for this purpose, the pasty mass obtained gradually hardens in the air, and attains equal hardness with the very best hydraulic cements. If, on the other hand, chalk in pieces or porous limestone is dipped into a solution of silicate of potash, they acquire, after several days' exposure to the air, such a degree of hardness at the surface that they scratch limestone; they admit of being polished, but it is only with porous stones that the hardening penetrates through the entire mass. This property may be usefully employed in the manufacture of ornaments, as, by judicious treatment, the surface experiences no alteration. The silification may even be employed for obtaining lithographic stones from chalk.

Gypsum is likewise hardened in the same manner, and its decomposition by alkaline silicates takes place far more rapidly and more completely. Crystallized gypsum is only superficially acted upon by it; but when ground and mixed with silicate of potash, it acquires a hard and shining surface. If too concentrated solutions are employed, the decomposition is too rapid, and the surface exfoliates after several days' exposure to the air. Oxide of manganese and potash may be employed with the same effect as the silicate of potash. The author ascertained, by experiments, that lime has the property of precipitating metallic oxides dissolved in alkalies; as, for instance, oxide of copper from its solution in ammonia. He observes, on this subject, that in general, every insoluble salt in contact with a saline solution, the acid of which forms with the base of the insoluble salt a still more insoluble combination, produces a decomposition of the salt in solution, which, however, in most cases, is incomplete. Thus white lead precipitates a considerable quantity of chromate of lead from a cold solution of chromate of potash; silicate of potash and chromate of lime yield some silicate of lime, &c.

The carbonic acid of the atmosphere acts a principal part in the hardening of these artificial stones, and on its exclusion they do not become hard. The silicate of potash contained in the mass is decomposed by the carbonic acid; silicic acid separates, which contracts, and so assists considerably the solidification.

When a solution of silicate of potash is exposed to the air, it solidifies in the course of fourteen days to a transparent jelly, which gradually becomes very hard without losing its transparency; and after the lapse of several months it is capable of scratching glass.

The author is inclined to suppose that the crystallized silicic acid in the limestone rocks, as also flints, agates, &c., owe their origin to this cause; that they have consequently been formed by the decomposition of the sili-

cate of potash by carbonic acid. In fact, he found, in examining these minerals, that, after ignition and pulverization, they communicated a decidedly alkaline reaction to water. In these siliceous deposits, the two following causes have been principally active:—

1. Decomposition of the earthy carbonates by alkaline silicates, producing earthy silicates, which are decomposed under certain circumstances by water containing carbonic acid, and part with the earths.

2. Direct deposition of silicic acid by decomposition by carbonic acid of the alkaline silicate held in solution in water.

The author finds a confirmation of his view in the circumstance, that, besides the minerals previously mentioned, manganese, dolomite, talc, asbestos, emerald, corundum, sulphuret of antimony, &c., contain small quantities of alkalies.—*Ann. de Chim. et de Phys.*, xxi, *p.* 364.

Lond. Chem. Gaz., July, 1848.

TO THE COMMITTEE ON PUBLICATIONS OF THE FRANKLIN INSTITUTE.

Remarks on Mr. Thomas Ewbank's Experiments on Paddle Wheels for Steamers.

The deductions made by Mr. Ewbank, from his experiments on paddle wheels, appear to me so erroneous that I have concluded to state wherein I think he has fallen in error, and to show that, even if the triangular paddle is preferable, there is nothing in the experiments of Mr. E. to prove it. When one paddle is stated to be superior to another, the power expended upon each one becomes an important element, without which the deductions are useless. From the way in which Mr. E.'s experiments were made, (having but one shaft common to both paddles,) he could tell nothing of the difference of power expended on each paddle.

Again, Mr. E. placed the inner edge of all his paddles the same distance from the centre of his shaft, (13 inches.) To make an accurate comparison, or, in fact, any comparison, the *centre* of each paddle should have been placed at equal distances from the centre. This will be obvious to any one by examining the two diagrams, No. 16 and No. 3,—the first being one of the most efficient paddles tried, and the latter the standard by which they were tested.

Fig. 16.

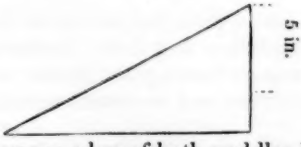
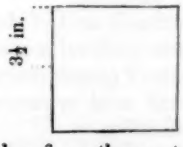


Fig. 3.



The upper edge of both paddles being 13 inches from the centre of the shaft, and the centre of No. 16 being 5 inches from the upper edge, while that of No. 3 is but 3½, it follows that the radius of No. 3 is 16½ inches, while that of No. 16 is 18 inches; or, in one revolution, the centre of 16 passes through 9·4 inches more than No. 3, which is conclusive evidence of its efficiency, and which is as easily demonstrated by diagrams as experiments.

Although there is much that is objectionable in Mr. E.'s remarks about the slip of the wheels of our sea steamers, as well as about the number of paddles, and also of the material of which they are formed, yet I have not time at present to examine them. B.

Note.—The centre of the area of the paddle is not, in either case, strictly the point from which to calculate, but it is sufficiently near in this case, and gives what advantage there may be to Mr. E.

Highton's Improved Electric Telegraphs.

There are now at the Euston station, temporarily erected for the inspection of the Directors of the London and North Western Railway Company, a series of improved electric Telegraphs; these improvements have been made and patented by Mr. Edward Highton, C. E., Telegraphic Engineer to the above Company, who seems to have investigated the subject very extensively and successfully, as far as can be judged at present from the specimens we have seen. One is an improvement on Wheatstone's, for simplifying the arrangement of the figures referring to the letters on the dial, by which the letters of more frequent occurrence are so arranged as to require the least number of ticks, saving about 15 per cent. of time.—The pointer is moved by means of a horse-shoe magnet, surrounded by multiplying coils of wires, and suspended on an axis, and is acted on so powerfully and directly by this arrangement, that it does not vibrate, which facilitates the reading. Another shows the letter telegraphed in an aperture on the dial, being an improvement on Mr. Nott's plan;—the latter had the disadvantage, when a wrong letter was telegraphed, of continuing the error throughout; there was no means of rectifying it; but Mr. Highton, by means of an instrument which he has invented, and calls a *perænode*, can reverse the current immediately, and rectify the error. The peculiarity of the instrument consists in its capability of completing, at a distant station, one of either of two different circuits, without the possibility of any accidental confusion. There is another with a neat dial-plate, showing the letters of the alphabet in a circle, and figures under them. The pointer in the centre of it is made to pass rapidly round, and when it comes to the right letter it is stopped for a moment. Should the wrong letter be telegraphed, the error can be immediately rectified, and, if worked skilfully, will save nearly half the usual time. The principal telegraph is worked by a system of lettered finger-keys, by which any desired letter of the alphabet can be made instantly to appear on the dial, without the passing of a single other letter. This is accomplished by means of three wires and "a certain mathematical law of variation," which Mr. Highton has discovered in the transmission of electric currents.

This telegraph has been named the "express telegraph" by the Directors, and appears to work with great facility. The mechanism is very simple. There are no wheels. The letters are shown by the movement of three pendulous screens, one behind the other, having certain openings and letters on them. They are moved to the right or left by the electric power, and do not vibrate, but show the desired letter steadily. Thus, with three

wires, and the corresponding system of keys, any of the 26 letters of the alphabet may be exhibited at a distant station, as fast as the operator can put his fingers on the keys representing them.

There are a variety of machines for printing the letters telegraphed—one, by means of the transposition of six symbols, all the letters are represented; another, which is nearly finished, will print the letters of a message in the usual type, without the chance of mistake, at a distant station, (by means of certain combinations, and three perænodes, connected with three wires,) as fast as the operator can point out the letters.

One great advantage in these improvements is stated to be, that it requires but little power to send the signals along the line, in consequence of its being transmitted to other and more powerful electric apparatus, provided at the stations, to receive it and show the signals. They are put in action when in use, and out of action when not wanted.

Lond. Rail. Jour., Oct. 1848.

The Improvement of Chronometers.

The talent and ingenuity which have been directed to the improvement of chronometers for many years past, have left but few defects in their conconstruction, excepting the imperfect compensation for change of temperature: this has formed the great object to which the efforts of persons interested in their improvement have been directed. The defect alluded to is this, that if chronometers are adjusted for extremes of heat and cold, they will gain in the intermediate temperatures. The cause of this defect is, that the balance-spring loses elasticity by an increase of temperature at an accumulating rate over the effect produced by the ordinary compensation. The great difficulty of obtaining a principle, the effect of which could be increased or diminished precisely in the same degree as the temperature increased or diminished the elasticity of the spring, has perhaps occupied more time, and led to more profitless experiments, than any obstacle which has ever opposed itself to the progress of chronometrical improvement.

Mr. Loseby has introduced mercury to achieve the object desired, which, by its fluidity, seems to admit of being adjusted so that its effect varies exactly in the same proportion as the change of temperature alters the elasticity of the spring, or in other words, which makes the law of the successive alterations of the momentum of inertia adapt itself to the law of alteration of the elasticity of the spring, whatever that law may be. *(Astronomer Royal's Report.)*

Since the invention was submitted to the Government in 1843, it has undergone several trials by order of the Board of Admiralty, with a view to test its principle. The chief points which required to be proved were, first, whether the principle admitted of being adjusted to the irregular loss of elasticity in the spring; and, secondly, if the effect produced by the mercury would be sufficient. The fluidity of the agent used at once answered the first point, and it was therefore to the second that the trials have been chiefly directed. The result shews that not only can the ordinary defect be obviated, but in most of the trials it has even been reversed.

The first trial commenced in January, 1845, when two chronometers were placed at the Observatory, Greenwich, under the direction of the Astronomer Royal, and underwent a rigorous ordeal, having been exposed to the open air on the north side of the building, during the coldest weeks of that severe winter, and also to temperatures varying from 85° to 120° Fahrenheit for the extreme heat. The Astronomer Royal's report, which was laid before the Admiralty in May, contained an account of the performance of these chronometers, and also his opinion relative to the principle. The following extracts are from this report:—"I consider this invention (taking advantage very happily of the two distinguishing properties of mercury, its fluidity and its great thermal expansion) as the most ingenious that I have ever seen, and the most perfectly adaptable to the wants of chronometers. I am not aware that it is liable to any special inconvenience." "I think it my duty to report as my opinion, that Mr. Loseby's construction has successfully effected its object, and remarking the ingenuity of the method used, and the fertility of its principle, I state as my opinion to the Board of Admiralty, that Mr. Loseby is entitled to their lordships' general encouragement."

Dr. Rae says, in his report of the Arctic expedition under his command, which returned last year, that nearly two months before the temperature reached 0° Fahrenheit, the chronometer employed became so irregular in rate as to be useless for taking the longitude. This of itself shews the importance of improvement. The annual trial of chronometers for purchase by the Admiralty is now concluded for the present year: it contained forty-eight chronometers of various makers, including two of Mr. Loseby's improved construction, one of which has obtained the first, and the other the third place in the rates published by the Government, for their superior merit.

We mention these facts, which seem little known beyond the Government departments, in justice to an ingenious man.

Lond. Build., Nov. 1848.

FRANKLIN INSTITUTE.

Stated Meeting.—Appointment of Committees.

A stated meeting of the Institute was held at their Hall, Feb. 15, 1849.

S. V. Merrick, President, presiding.

M. T. W. Chandler, Recording Secretary, *pro tem.*

The minutes of the last meeting were read and approved.

Donations to the Library were received from Hon. Jos. R. Ingersoll, Hon. R. S. Baldwin, Hon. A. C. Greene; Messrs. D. Appleton & Co., and Messrs. A. S. Barnes & Co., New York; Thos. H. Forsyth, Esq., A. B. Hutton, Esq., Henry Nolens, Esq., Prof. Wm. Vogdes, and The Mine Hill and Schuylkill Haven Railroad Co., Philadelphia; and Wm. Jackson, Esq., Newton, Mass.

The Treasurer reported his monthly statement.

The Board of Managers and Standing Committees reported their minutes.

The Chairman of the Committee on Exhibitions reported that, in ac-

cordance with the report from the Committee on Science and the Arts, they had awarded the "First Premium" to Mr. Paul Stillman, for his "Engine Register and Manometer Steam and Vacuum Gauge."

The Standing Committees for the ensuing year were appointed as follows:

Library.

John Allen,
Wm. P. Cresson,
Wm. S. Levering,
John P. Parke,
Daniel Rhoads,
Wm. Roberts,
Jacob D. Sheble,
Stephen D. Steele,
Alan Wood,
Geo. J. Zeigler.

Cabinet of Models.

John Agnew,
A. L. Archambault,
H. P. M. Birkenbine,
B. M. Feltwell,
Henry Huber, Jr.,
J. Vaughan Merrick,
Wm. D. Parrish,
Thomas S. Stewart,
Thomas U. Walter,
Thomas F. Williams.

Cabinet Minerals & Geol. Specimens.

C. F. Beck,
J. C. Booth,
M. H. Boyé,
John F. Frazer,
R. E. Griffith,
Edwin Greble,
Jas. S. Lippincott,
Wm. Pettitt,
Richard C. Taylor,
A. W. Thompson.

Cabinet of Arts and Manufactures.

James C. Booth,
John C. Copper,
James Euston,
C. M. Ghrisky,
Wm. Harris,
A. L. Kennedy,
Wm. P. Troth,
G. L. Thomas,
Isaac S. Williams,
T. J. Weygandt.

Exhibitions.

John Agnew,
John E. Addicks,
John C. Cresson,
Owen Evans,
Jas. P. Ellis,
Thos. Fletcher,
Benj. Huckel,
Solomon W. Roberts,
John Wiegand,
C. A. Walborn.

Meteorology.

Samuel W. Black,
Charles M. Blake,
M. T. W. Chandler,
Emlen Cresson,
Owen Evans,
Gouverneur Emerson,
James P. Ellis,
Jas. S. Lippincott,
John Simmons,
R. P. Thomas.

Meetings.

Joseph M. Cardeza,
Chas. B. Foster,
B. B. Gumpert,
Wm. E. Morris,
Franklin Peale,
J. B. Reynolds,
B. H. Rand,
Geo. W. Smith,
James Swaim,
Return Sheble.

Mr. Geo. W. Smith called the attention of the meeting to the Lantern and Apparatus (now in the room) of the lighthouse now in process of construction on the Brandywine Shoals. It is a Fresnel fixed light of the third order. He regretted the absence of Mr. Lewis, the contractor, caused

by his detention in Boston, and explained to the meeting the difference between the systems of Catoptric and Dioptric Lights, employed in the lighthouses in Europe and the United States, and described the great advantages of Fresnel's, which he illustrated by diagrams and large drawings; he also gave an historical sketch of the various improvements in lighthouses.

Mr. Laban Morse, of Athol, Mass., exhibited a model of his furnace for burning sawdust under steam boilers, and explained its peculiarities,—which consists of a corrugated plate, perforated with numerous small holes, substituted in the place of the ordinary fire bars.

Prof. J. C. Cresson exhibited and explained Mr. Paul Stillman's Engine Register and Manometer Steam and Vacuum Gauge for Steam Boilers. A drawing and description of this beautiful apparatus is given in the proceedings of the Committee on Science and the Arts.

At the desire of Mr. Smith, Prof. Frazer exhibited a model of the Cavendish Apparatus for the determination of the mean density of the earth—explained the principle of its determinations, and gave the results obtained from it by Cavendish and the late Mr. Bailey.

Mr. Smith informed the meeting that these experiments would probably be repeated in this country, with even additional precautions to insure accuracy.

Mr. S. W. Roberts called the attention of the members to a well executed topographical plan of the proposed extension of the Mine Hill and Schuylkill Haven Railroad across the Broad Mountain, from Coal Castle to Ashland and Shamoken, from surveys made in 1848 under his direction.

COMMITTEE ON SCIENCE AND THE ARTS.

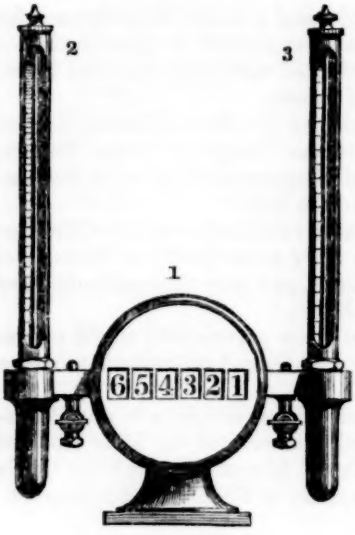
Report on Mr. Paul Stillman's Engine Register and Manometer Steam and Vacuum Gauge.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination and report, an "Engine Register and Manometer Steam and Vacuum Gauge," invented by Mr. Paul Stillman, of the City of New York, REPORT:—

That the instrument referred to is designed for application to marine steam engines, and that it is, in outward appearance, similar to the marginal sketch.

It is three-fold in its purposes—consisting, 1st, of a circular cast iron box, faced with a dial, in which are cut side by side, six (or more as may be required) slots, through which may be seen the numbers representing the revolutions of the engine; this is denominated the "counter" or "register;" 2d and 3d, of two gauges, one for steam, the other for vacuum, connected by suitable pipes with the boiler and condenser. Both these latter consist of vertical glass tubes, hermetically sealed at their upper ends, and having their lower ends immersed in small chambers, (the joints being insured perfect by tinning the brass glands surrounding the tubes.) These chambers communicate with the reservoirs for the mercury only by the lower end of the small chamber, into which is screwed a plug; so that it is only by the minute leakage around this screw, that the same pressure is maintained on

the mercury in the tube and that in the reservoir. The object of this arrangement is to prevent the too rapid agitation of mercury consequent on differences in pressure, and also to enable the tubes to be filled and then inverted in their reservoir, without loss to the contents,—in fact, supplying the place of the bulb in common gauges.



The steam gauge then, having been partially filled, indicates by the compression of air, caused by the forced ascent of the mercury; and the vacuum gauge, being at first entirely filled, indicates by the descent of mercury, as in common gauges. To prevent, in the steam gauge, the soiling of the tube, caused by the oxidation of the mercury, a small quantity of naphtha is introduced on its surface. These gauges are thus presented in a compact form, and in a manner not very liable to derangement. But as it would require a practical experience to test their supposed advantages over those in common use, the Committee, at present, will confine themselves to a consideration of the Register, of which the following is a description:

By an attachment to any suitable part of the engine, a vibratory motion is communicated to an arm attached to a central horizontal shaft, placed parallel to the dial, and within the cast iron box—to the ends of which is also fixed a frame carrying a small shaft parallel to the former, on which six palls or arms are attached, side by side, and at a certain distance apart, in such a way that the right hand pall may fall without the others, but cannot rise without carrying all the rest.

This framework, with the pall-shaft, &c., is made, by the motion of the arm attached to the engine, to describe an arc of 36°, or to move through one tenth of a circle.

The ends of the palls respectively rest on, and slide over, six cylinders placed side by side on the central shaft, all of which are free to move in the same direction and independently of each other, and are arranged in the following manner:—

For the sake of clearness, we shall number them 1, 2, 3, 4, &c., beginning with the right hand one.

On the right hand edge of each cylinder are cut 10 slots, and on the left hand, which overlaps the edge of the next, only one slot; these slots being of such a size as will admit the end of one of the palls; then on the back motion of the framework, &c., the pall is carried back till it drops in, when the forward motion carries with it the cylinder so locked.

In the central spaces (between the laps) in each cylinder, and opposite to one of the slots in the dial face, the numbers 1, 2, 3, &c., to 0, are engraved at equal distances round the circumference. The palls are placed

one over each of the slots, so that the pall can fall into the inner cylinder only when the slot in the outer one comes directly under it; and as this occurs only once in a whole revolution, and as the motion of the palls is only through one tenth of a circle, it follows that cylinder No. 2 can only be moved through one tenth of its circumference, after cylinder No. 1 has moved a whole revolution, or ten times that space, and so on. Thus, if the figures on No. 1 represent units, those on No. 2 will be tens, on No. 3, hundreds, &c.; and extending the same principle, No. 1 must move round one hundred thousand times to produce one revolution of No. 6. It will be observed that every revolution of the engine must insure one tenth of cylinder No. 1 to move round, inasmuch as the ten slots in its right hand edge are not covered by any other cylinder, as is the case with the rest.

The cylinders being free to move in the direction of their motion, or *forward*, they may be adjusted at any time to their starting point, without deranging any of the palls, or even opening the case.

The Committee judge the following to be the advantages of this arrangement:—

1. The compactness and symmetry.
2. The ease with which the result may be read. And,
3. The facility of adjustment.

The two latter being important considerations in an apparatus of this kind.

Other uses are obvious to which this principle may be applied; as, for example, to gas meters, or any other instrument requiring a register, although in the former case, the increased power required to turn the cylinders when the higher grades of figures come in play, *might* prove an objection. Of this the Committee are not capable of judging, for the model submitted to them is intended for a marine engine, and consequently is of sufficient strength to withstand the rough usage it might meet with, and consequently requires greater effort to move it.

The arrangement is also probably of less expense than the old form of counter.

In view of all which points, the Committee are of opinion that Mr. Stillman is entitled to the First Premium awarded at the Exhibition, where it was placed by him in October last.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, February 8, 1849.

Report on the Survey of the Coast of the United States.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, to whom was referred for examination and report the subject of "The Progress of the Survey of the Coast of the United States," REPORT:—

That the Survey of the Coast of the United States is one of those great national duties which our government owes to its own citizens and to the world at large. In the present advanced condition of civilization and enlarged commerce, it would be a matter of great surprise

should we find so important a duty overlooked entirely, or prosecuted with such unwillingness as to cause it to fail in its practical benefits to society.

The duty of a government constituted like our own, whose care of the commerce of the country is exclusive of all interference from the States, and extends over a greater sea, bay, and river border than that of any other in the world, is, perhaps, more imperative upon this point than that of the governments of countries of more limited space in these particulars.

The importance of such knowledge as an accurate measurement and delineation of the coast would give, was early felt by the people and authorities of the Union, and the plan for such a survey, to be prosecuted with the best lights that physical science then afforded, was adopted by President Jefferson in the year 1807, and the appointment of the late Mr. Hassler to the office of Superintendent, was made by him.

Owing to the difficulties in which the country became involved about that time, from the disturbed condition of Europe, and to the subsequent war which took place between the United States and Great Britain, Mr. Hassler was unable to procure the necessary instruments for the work, or to undertake its prosecution, until the year 1817. Shortly afterwards the law under which he had been appointed was modified, so as to exclude civilians from official positions on the Survey; and it was not until the year 1832 that Mr. Hassler, under a re-appointment, commenced his labors in actual service.

From that time until his death, which occurred in the year 1843, he was engaged in prosecuting the work in the northern part of the United States, and his measurements embraced portions of the States of Delaware, Pennsylvania, New Jersey, New York, Connecticut, Rhode Island, and Massachusetts.

Although the actual labors in the field were great, and much valuable information was collected, it was not deemed expedient by the late Superintendent to publish the preliminary results to any great extent, in the form of maps and charts.

In 1844, Prof. Alexander Dallas Bache was appointed to the office of Superintendent, made vacant by the decease of Mr. Hassler, and he immediately addressed himself, first, to the proper measures for closing up and verifying the work of his predecessor, and second, to the publication of the ascertained results in a practical form.

The credit, therefore, due to his predecessor, having been fairly and fully awarded, Prof. Bache could safely complete the triangulations of those portions of the coast, and commence the publication of the maps and preliminary sketches; thus rendering the work immediately available. While this has been the case with the work as it stood in 1844, new base lines have been measured to the north and south of Mr. Hassler's work, and the Survey is now progressing in eighteen States on the Eastern Coast, and a party organized for the preliminary examination of the Western Coast.—When the Committee states that these labors cover the whole of the coast line on the Atlantic and Gulf of Mexico, with their tributaries, and are intended to extend over the whole of our coast line on the Pacific Ocean, with its immense but little known tributaries, some idea may be formed of the scope and value of such a survey. It first addresses us in its practical character as a commercial nation—the second in the world, whose foreign

commerce in imports and exports amounts to about $300,000,000 annually, and whose domestic or coasting trade is probably equal to as many millions yearly. In the year terminating June 30, 1847, 14,229 vessels, of an aggregate tonnage of 3,321,705 tons, arrived in the ports of the United States, and 14,370 vessels, of an aggregate tonnage of 3,378,993 tons, cleared from the same. The tonnage employed in the coasting trade was 2,839,045 tons, and some of these coasters make ten or twelve trips per annum. The number of emigrant passengers that arrived from foreign countries was nearly 240,000, and the officers and mariners engaged in our maritime commerce amount probably to 100,000 souls.

We can scarcely conceive of the perils to which such a mass of property and life is subject, in approaching our extensive and dangerous coast; and although lighthouses and buoys have been erected, to mark its most hazardous places, there are others, hidden beneath the waters that wash our shores, perhaps equally perilous, which can only be ascertained, and become generally known, by accurate soundings and charts.

Independently of the ordinary results of the operations of the Coast Survey, as given in the annual reports, and preliminary sketches and maps, two great natural approaches, before unknown, have been discovered, and verified in such form as to mark them distinctly for use by the mariner;—we refer here to Gedney's Channel, in the harbor of New York, and to Blake's Channel, in Delaware Bay.

Of equal merit, but not yet so distinctly made available for practical purposes, are the newly discovered shoals off Nantucket, the examinations of Chesapeake and Mobile Bays, and some of the dangerous parts of the coast of North Carolina.

The investigations of the width and direction of the current of the Gulf Stream, that great physical wonder, its temperature and depth, will no doubt be of as great practical, as it is of scientific, interest. The phenomena of the tides, and of the currents of the oceans and rivers which wash and water our territories; the nature and changes of the bottom, both in the shallow and deep places, are highly curious and practical.

Nor ought we to overlook, in such a summary, the accurate delineation of the topography of the country bordering the shores. On every side, and every where, the Survey applies the scale of truth and science to the crude and imperfect locations and measurements of former times, and presents us with perfect, or nearly perfect, work.

Entrances to harbors and bays have been found to vary from the received proportions by miles; lighthouses and dangerous points in the navigation, have had their locations corrected; and the confiding mariner made safe in his approaches.

It is only necessary for any one who doubts these great results, to procure the most approved of the old charts and maps, and compare them with the work of the Coast Survey. The members of the Institute may readily do this, by an examination of the new chart of Delaware River and Bay; they will rise satisfied, from such an examination, that every attention has been given to secure accurate results; and it will be apparent to them, how valuable similar works must be to their fellow citizens in other parts of the Union. But it is unnecessary for us to confine ourselves to the commerce of the nation, in an enumeration of the practical benefits of

the Coast Survey. The work that has been wrought out with so much care and accuracy, to fix prominent points along the coast, may be equally relied on by the State and Municipal authorities, for local or more extended measurements, by the triangulation of the areas of cities, counties, and States.

As land becomes valuable, and the conflicts for its possession increase in number, the importance of authenticated measurements, made independently of any such considerations, will be more and more obvious; and it will doubtless soon become the policy of each State, if not of the subordinate parts of it, to compare the boundary lines of public and private locations, as they now imperfectly or arbitrarily exist, with the great triangulations of the national work; and correct them with, and mark their relation to, these measurements, by the application of the same methods that are now used in them. By such a system, not only would private litigation on the subject of boundaries be much diminished, but accurate maps would be produced, and take the place of those imperfect and deceitful sketches now in use.

Of the scientific methods used in the labors of the Coast Survey, it will be sufficient for us, perhaps, to say, that they embrace all that is now known, either in this country or in Europe, and that, in the establishment of new formulæ, or in the application of old ones, those entrusted with the work maintain a high position.

Our limits will not permit us to institute comparisons between the rapidity and correctness with which our work is going on, and those of similar character that are now making by other nations. The testimony of Col. Everest, who recently visited this country, and who was charged with the superintendence of the great survey of India, emphatically marks it as equal to any with which he is familiar. And we know, by an examination of the history of the published results abroad, that the Survey of the Coast of the United States is more rapidly prosecuted than any other national work, and its results placed in the possession of the public with more promptness.

In point of economy, although from its nature large amounts of money must be annually expended, it can scarcely be said to exceed the price of our ordinary surveys of the public lands, while its results are much more to be relied on.

This economy is, in a great measure, due to its peculiar organization; while it embraces army and navy officers of the medium grades, and uses their peculiar professional skill and knowledge, it relies more largely on the employment of civilians, and thus blends into harmonious action those who can best contribute to its great objects. The Superintendent is of course a civilian, and such should be the case from the very nature of his duties. They are varied, comprehensive, and require peculiar habits of thought and action, that are rarely attained in the camp or on board the ship. The chief of the Survey cannot, without great hazard, be rendered subject to the contingencies which affect the military and naval service, because the great value of his labors depends upon the soundness and extent of first preparations, and the gradual but steady filling in of the details marked out by previous study. The computations, drawings, observations, and measurements; the engravings and other artistical work connected with

the subject, must, to a great extent, be the work of civilians; and while the head should be able to command the respect and confidence of the military and naval officers of the country, he ought also to be possessed of that practical knowledge of scientific and mechanical pursuits, that will enable him personally to direct and control the minutest details. In these respects we consider the work most happily organized, and tending to the best results. The arrangements by which the services of the different individuals employed are adjusted, the proper distribution of labor among them, and the subdivisions of the corps into effective working bodies, are all well adapted to secure harmony and efficiency. The success of these arrangements is well shewn in the published results, and if the finished maps be considered merely in the light of mechanical productions, they will reflect high credit on the artists; but when they are examined with reference to their scientific and practical value, the skill and talent bestowed upon them challenge the most delicate criticism.

The Committee has been struck with the perfection of the organization of the business of the Survey.

It has been arranged so as to meet the complicated responsibilities of a large number of individuals of different capacities, and laboring in different fields, but whose results must be combined in order to perfect the whole work. Each of these different individuals is, in some sense, a check upon the whole, and he either contributes to the correct result, or is himself convicted of error.

In this respect, the Survey is a great national scientific school, in which the young men from all parts of our extended country may actively participate in its labors in the field, or, by means of its connexion with our colleges and other schools, become familiar with its methods of examination and computation, and compare them with those which claim the attention of the educational institutions and scientific men of Europe.

We have already glanced at its economy, and in connexion with what we are now considering, we would say that, independently of the vast practical benefits which are flowing from the work, a nation like our own might well afford to contribute its quota to the sum of human inquiry, by keeping a portion of its citizens, equal in number to those now employed in the Survey, engaged in the investigation of the several branches of physical science that fall regularly within its duties. In these relations it connects us with the movements of general science throughout the civilized world, and will enable the men of science of our own land to vie with the philosophers of other nations, in the value and extent of their investigations. Spread, as these investigations are, over many States, local prejudices retire before the lights which they furnish, and every new field that they reach will, in its turn, yield fruit to the general harvest.

If we direct our attention to the scientific character of the Coast Survey, we find that it is making large contributions to knowledge and the arts. It calls to its aid all the physical sciences, and applies them for the determination of valuable practical results. Thus the higher mathematics used in the reductions of the astronomical, magnetic, and geodetic observations, give formulæ which may be applied to objects entirely distinct from the immediate work.

The explorations of the depths and bottoms of our sea coast, bays, and

rivers, afford a large field for the more minute investigations of the botanist, the geologist, and the observers of all kinds who delight in the examination of animal life in its various extended forms. The topography makes us familiar with the character of the surface, and the nature and extent of the cultivation of the soil.

The magnetic and meteorological observations will become valuable in their applications to the study of climate and general temperatures. The observations for latitude and longitude will designate with certainty the true positions of our cities, and other places of interest in a national point of view; and give greater precision to our knowledge of the sphericity of the earth, and of the relations of the meridional and equatorial arcs which are within the extended bounds of the Survey.

It has given rise to improved methods of observing angles and azimuths, and has furnished valuable formulæ and tables for determining latitudes and longitudes, by reference to its great bases. It has brought the aid of the magnetic telegraph, and magnetic and electric clocks, to practical use in the determination of the longitude of our cities and important inland points. New and improved apparatus has been constructed for ascertaining temperatures; for constructing and dividing the delicate instruments used in the terrestrial and astronomical measurements; for determining the meteorological and magnetic states of the atmosphere; for discovering the true character of the soundings; and for measuring the direction and velocities of tidal and oceanic currents. The astronomical observations will embody a vast amount of information on the subject of celestial phenomena, and by their number and extent, tend greatly to the verification of those results that have been obtained by the terrestrial measurements. It is difficult, indeed, to determine where its value, in a strictly scientific sense, would terminate; because it explores every walk of known science, and is daily returning new discoveries for the aid which the elder ones had furnished to it.

After a careful consideration of the whole subject embraced in the examination of the Coast Survey, the Committee would express the following conclusions:

First, That the work is national in its character, and ought to be continued by the Federal Government, upon a scale commensurate with its practical importance, and with the extent and variety of the objects which are benefited by its results.

Second, That the manner in which it is at present organized, is economical, efficient, and scientific; giving its results with sufficient rapidity, at moderate cost, and upon correct scientific and practical principles.

Third, That its labors ought to be (as they now are) divided among the civil, military, and naval, talent of the country, in order to secure to each of these departments that knowledge of its processes and determinations which are equally required by them all.

Fourth, That the benefits which the nation has already obtained from it have fully justified its cost, and that those benefits ought now to be continued to the whole of the States of the Union, upon as broad and liberal a scale as the Government has hitherto applied.

By order of the Committee,

WILLIAM HAMILTON, *Actuary.*

Philadelphia, February 8th, 1849.

BIBLIOGRAPHICAL NOTICES.

An Elementary Treatise on Optics; by J. W. JACKSON, *Professor of Mathematics and Natural Philosophy in Union College. New York: A. S. Barnes & Co.; Albany: D. S. Derby & Co.; Cincinnati: H. W. Derby & Co.* 1848.

Owing to the kindness of a friend, we have had the first portion of this work in our possession for some time, and have had an opportunity of giving it a more attentive study than our time usually allows us, before noticing works sent to us for our opinion.

We have, then, no hesitation in commending it as the best text book for the teaching of optics in our colleges which has met our eye.

The arrangement is methodical—the language simple and perspicuous; the method of treating the subjects purely scientific, and the mathematics as elementary as the proper treatment of the subject admits of. It is easy to be seen, by any one familiar with the subject, that the author has not only read the best authors, but that he has exercised a very high degree of judgment in the selections which he has made from among them, and reflected deeply upon the subject before he gave his results to the public. In his brief and modest preface, the author states that "the only merit the case admits of, is that which may be claimed for a judicious choice of matter and methods, and the reduction of them to a uniform and consistent whole." This is a merit to which he is fully entitled, and we hope that he will find inducements to proceed to other branches of physico-mathematical science, and furnish our institutions of learning with works of equal merit.

F.

A Catechism of the Steam Engine, &c., &c.; by JOHN BOURNE, C. E.—*From the last London edition. New York: D. Appleton & Co.; Philadelphia: G. S. Appleton.* 1849.

This valuable little book is a reprint of an English work, by the author of a larger treatise on the steam engine, published in the name of the Artizan Club. The present volume professes to be merely "an introduction, and, in some measure also, a supplement to that work;" but it is, in all matters which it contains, very far superior to it—being written, apparently, with less haste and more care, and therefore more accurate in its statements. The larger work is principally valuable to the engine manufacturer, on account of its details of engines and boilers. The present treatise is intended to give the requisite general knowledge of the principles of the construction of the engine, and the explanation of the peculiarities of structure of its various forms. We regard it as a very valuable addition to our list of books upon this subject. The explanations are generally plain and easily comprehended; and the principles laid down are for the most part correct. In certain matters, the data are not those given by the